DRAFT STUDY MATERIAL

SPECIALIZED SEWING MACHINE OPERATOR

(Qualification Pack: Ref.Id.AMH/Q2301)

Sector: Apparel, Made-ups & Home Furnishing

(Class XII)

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
(A constituent unit of NCERT, under MOE, Government of India)
Shyamla Hills, Bhopal- 462 002, M.P., India
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Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

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20 June 2024

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Module 1	Introduction to Garment Pre-Production Processes

Module Overview

Specification sheet is the document where in details of the measurements, design and construction is given. It is the communication between the designer, manufacturer and the buyer. Specification sheet plays a very important role in apparel manufacturing for the development of quality product. Tech Pack is a set of instruction sheet to create apparel starting from scratch. It comprises of additional detailed information of wash and care labels, prints etc. so it is not just a spec sheet that will do your job if you want to produce apparel.

There are different spec sheets for different department of a garment industry like measurement spec sheet, construction detail spec sheet, embroidery specs sheet etc. Before mass production of an apparel product, manufacturing units need to make sample. First the initial specification sheet is made for developing proto sample. After that the specification sheet is revised according to the changes in the fitting of the sample with constructional details.

As per specification sheet, final sample is then sent to the buyer for approval. Buyer adds comments on the specified sheet for the modifications on measurements, workmanship and material. After the final sample development, the bulk production starts.

Therefore, at all levels of production specification sheet is very important and all these aspects are discussed in this unit.

Learning Outcomes
After Completing This Module, You Will Be Able To: • Specification sheet • Explain the pre-production operations in an apparel industry • New attachments of sewing machine
Module Structure
Session1: Specification Sheet
Session 2: Pre-Production Operations in an Apparel Industry
Session 3: New Attachments of Sewing Machine

Session 1: Specification Sheet

Definition and Content of Specification sheet

A working sheet containing the details of the garment design and construction is called specification sheet or spec sheet. It is the useful instruction manual for sample makers and designer in paper by the product designer. Tech-pack is detail version of a spec sheet.

Designer makes the spec sheet to communicate design detailing and its construction. A garment spec sheet includes the garment sketch (the sketch can be made by hand or using template). Measurement sheet for garment sizes - all sizes to be made for a design, remarks and comments. Designer remarks special notes on the sheet to communicate additional things, instruction for workmanship, stitching details with SPC (Stitch Per centimeter), needle size and seam types to be used.

Spec sheets are made in computer by using spec sheet template or tech-pack developing software. Garment manufacturers are supplied specification sheet in pdf format.

Correction on spec sheet is done after sample development. Before mass production of an apparel product, manufacturing units need to make sample. First the initial specification sheet is made for developing proto sample. After that the specification sheet is revised according to the fitting in sample and garment construction. As per specification sheet final sample is developed and sent to the buyer for approval.

At each stage of sample approval, buyer adds comments on the specified sheet for the modifications on measurements, workmanship and material. After the final sample development, the bulk production starts.

Normally garments specification sheet contains the following:

- Measurement chart

SAMPLE REQUEST FORM

MEASUREMENTS	M	FIT	APPROVED
BODY LENGTH FRM HPS	37½		37½
SIDE SEAM LENGTH	27½		27½
ACROSS FRONT	13		13
ACROSS BACK	13½		13½
CHT BELOW ARMHOLE	36		36
WAIST BLW HPS	32		32
HIGH HIP BLW TOTAL	38		38
LOW HIP BLW TOTAL	37½		37½
BOTTOM SWEEP	40		40
SLEEVE LENGTH	22½		22½
RAGLAN FRT	16½		16½
BICEP/C BLW ARMHO	13		13
SLEEVE OPENING	5		5
RAGLAN BACK	12½		12½
NECK WIDTH	7		7
FRONT NK DROP	3¼		3¼
FRONT NK DROP	3 3/4		3 3/4
BACK NK DROP	½		½
COLLAR POINTS	3		3
COLLAR LENGTH	16		16
COLLAR WIDTH	2¼		2¼
COLLAR STAND HT	1¼		1¼
FRONT PLACKET WID	1		1
BELT LENGTH	35½		35½
BELT WIDTH	2½		2½

HARDWARE & TRIM: LARGE / BODY BUTTONS

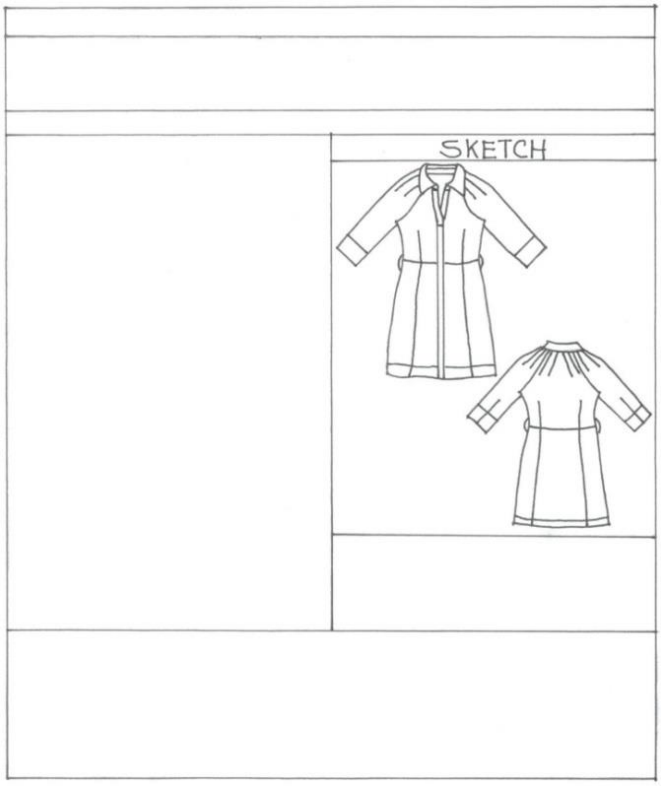
COLORS: BLACK, BLUE, TURQUISE

COMMENTS: - TOTAL CIRCUMFERENCE MESUREMENT

NOTE :-

(a)

- Sketch or design of the product



(b)

- Other details

DRESS TECH PACK

SEASON	FALL 2009	DATE	1/11/09	FABRICATION	COTTON
STYLE #	DAS-1653	DESIGR	S.K	FABRIC DESIGN	BACK & WAIST
DESCP.	SLEEVE SEAMLESS				

(c)

- Fabric type

  Ornamentation instruction (embroidery, printing, etc.),

  Stitching instruction (seams and stitches),

  Accessories instruction (zippers, pockets, etc.),

  Garments washing instruction,

  Different label instruction,

  Necessary comments related to the product.

1. Sketch or design of the product

It is the basic look of the garment to be developed. It is shown to the buyer for its confirmation.

2. Measurement chart

Measurement chart or measurement sheet includes various size measurement of the design for grading. For developing pattern this sheet acts as a guideline.

3. Fabric type

Detail information of the fabric, woven or knitted, cotton or some other types of fabric, colour of fabric etc.

4. Ornamentation instruction

Embroidery and printing instruction related to print or embroidery details for the item. Printing instruction includes type and size of the print and its location. For example, Embroidery instruction means the motif size, its placement.

5. Stitch instruction

In stitch instruction various information about the stitch requirement includes type of thread, stitch type, stitch density for the item.

6. Garments washing instruction

Some garments need special treatments which are instructed here. Garments washing instruction includes types of wash, auxiliaries to be used, temperature to be maintained etc.

7. Accessories instruction

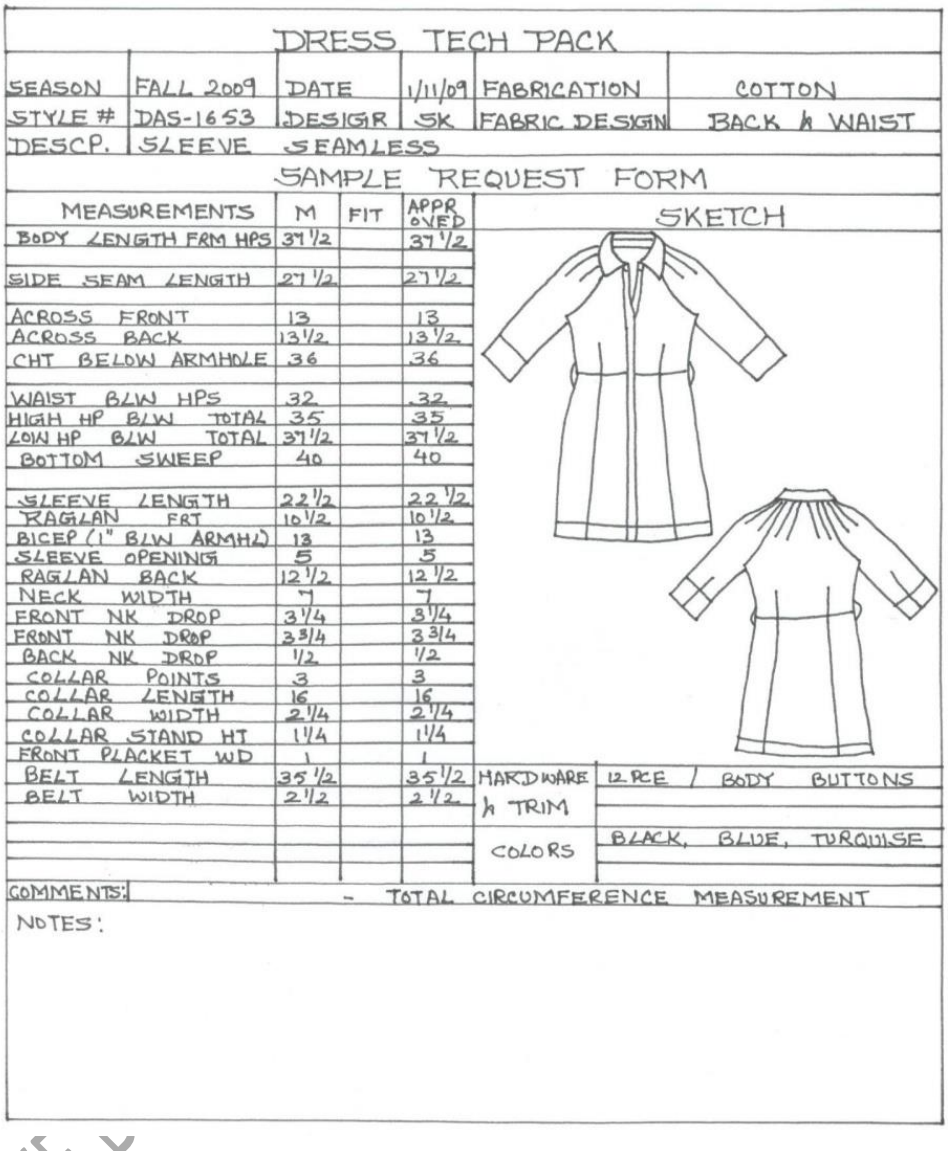
Accessories instruction contains information about the required types of accessories needed for that particular garment.

8. Label instruction

Label instruction contains information and placement about various types of label which includes main label, care label, size label etc.

9. Necessary comments related to the product

If buyers want to comment / suggest for manufacturing methods it can be done here. This is of great help to the operator who is actually manufacturing the product conceived and designed by the designer on the specifications provided.



DRESS TECH PACK

SEASON	FALL 2009	DATE	1/11/09	FABRICATION	COTTON
STYLE #	DAS-1653	DESIGR	SK	FABRIC DESIGN	BACK & WAIST
DESCP.	SLEEVE SEAMLESS				

SAMPLE REQUEST FORM

MEASUREMENTS	M	FIT	APPROVED
BODY LENGTH FRM HPS	37 1/2		37 1/2
SIDE SEAM LENGTH	27 1/2		27 1/2
ACROSS FRONT	13		13
ACROSS BACK	13 1/2		13 1/2
CHT BELOW ARMHOLE	36		36
WAIST BLW HPS	32		32
HIGH HP BLW TOTAL	35		35
LOW HP BLW TOTAL	37 1/2		37 1/2
BOTTOM SWEEP	40		40
SLEEVE LENGTH	22 1/2		22 1/2
RAGLAN FRT	10 1/2		10 1/2
BICEP (1" BLW ARMHL)	13		13
SLEEVE OPENING	5		5
RAGLAN BACK	12 1/2		12 1/2
NECK WIDTH	7		7
FRONT NK DROP	3 1/4		3 1/4
FRONT NK DROP	3 3/4		3 3/4
BACK NK DROP	1/2		1/2
COLLAR POINTS	3		3
COLLAR LENGTH	16		16
COLLAR WIDTH	2 1/4		2 1/4
COLLAR STAND HT	1 1/4		1 1/4
FRONT PLACKET WD	1		1
BELT LENGTH	35 1/2		35 1/2
BELT WIDTH	2 1/2		2 1/2

SKETCH

HARDWARE & TRIM	12 PCE / BODY BUTTONS
COLORS	BLACK, BLUE, TURQUISE

COMMENTS: - TOTAL CIRCUMFERENCE MEASUREMENT

NOTES:

(d)

Fig.1.1 (a, b, c, d): Sample tech pack

Garments specification sheet is an important document for manufacturing any garments. The specific objective of developing and providing garments spec sheet is to develop understanding of the development of the final product.

IMPORTANCE OF SPECIFICATION SHEET

Specification documents provide details of the operation, accessories and sizing for the apparel product. It is important for the following categories: business, operation, manufacturer and customer. The importance of specification sheet for different purpose is as follows:

1. **Importance of specification sheet for business**

- Specification sheet used as blueprint: The specification sheet is important for sampling section so that the sampling in charge may be able to re-create the described sample on a larger scale. Here, the specification sheet serves as something of a blueprint for the section. In charge will read over the specifications, and pursue according to their requirement.
- Specification sheet is useful for evaluating cost of product: A specification sheet is useful for evaluating cost carefully. A spec sheet gives exact cost required to complete a given product to the manufacturer.
- To compete in the market: With the help of specification sheet manufacturer can study the market and predict about other competitive products that might be received, then decides the number to be put forward.
- To make secrecy: The spec sheets given to manufacturer are highly secretive.
- To give clarity: Both manufacturer and buyer are clear with explanation and examination before making specification and component purchases. The spec sheet gives clarity about the final product.

2. Importance of specification sheet for construction/operations

A well written specification sheet can help an apparel to move along more smoothly and therefore be more perfect. For operation the specification sheet is used as;

- Agreement on exactly how the system will operate.
- Description of points of synchronization for the operational team.
- Making of a master plan and schedule.
- Instructions sheet to supervisors or operators.
- The specification document that contain a detailed description of the operation, accessories, material and design of the system
- General operating methods for each type of machines used.
- Human-Machine Interface (HMI) screen definitions and functions
- Interface instruction manual with other intelligent devices (communications protocols, expected message types, etc.)
- Description sheet for packaging material size.
- Bar code information (symbol, size, placement, etc.)
- A baseline for change control.

3. **Importance of specification sheet for manufacturer**
   - Ensure manufacturer to understands goals, specifications, and expectations
   - Brings manufacturer to personnel into the design phase to ensure they have a better understanding of what they are requesting
   - Manufacturer to personnel gain a greater sense of ownership of the design and increases the internal buy-in to the project
   - Helps to keep open channels of communications with manufacturer
   - Helps to drive a shared vision of the project.

4. **Importance of specification sheet for customer**

   Brings the customer in as a team member. The best method for creating the specification is an iterative approach with joint input, review, and approval. This creates many benefits both for the supplier and the customer.

Activities

Activity 1: Prepare any one specification sheet including details like fabric type, seams and stitches, accessory details, surface ornamentation.

Material Required:

1. Chart sheet
2. Pen/pencil, eraser, markers
3. Ruler

Step by Step Procedure:

1. Select any apparel product design for making specification sheet.
2. Student may also browse the specification sheet through internet and find the garment specification sheet.
3. List out content of that product according to the requirement of specification sheet.
4. Interpret the details one by one.
5. List out the garment specification sheet according to their product type.

Check Your Progress

A. Fill in the blanks

1. _____ _____ is an important document for production of any garment.
2. In a specification sheet information related to embroidery is called _____ _____.
3. Firstly the initial specification sheet is made for developing _____ _____.
4. At each stage of _____ _____, buyer adds comments on the specified sheet.

B. Match the Column:

1.	Product Requirement Specification	a)	PDS
2.	Human-Machine Interface	b)	PRS
3.	Bar code information	c)	Specification sheet
4.	Created by buyer to the manufacturer	d)	HMI
5.	Product Design Specification	e)	Symbol, size, placement, etc.

C. Questions:

1. Explain all content of specification sheet.
2. Explain specification sheet and tech pack
3. Explain the importance of specification sheet for business, manufacturer and customer.

Session 2: Pre-Production Operations in an Apparel Industry

Pre-production processes are the processes that are done before starting mass production. This process includes sample development, its approval, orders and testing of raw material. It is very important for the efficient working.

PRE-PRODUCTION PLANNING

The processes that are done prior to start of bulk garment production are known as pre-production process. It includes sample development, its approvals, research and development work for orders, testing of raw material and pre-production meeting. These processes are very important for the efficient production. The pre-production processes for an export house are given below:

FLOW CHART OF PRE -PRODUCTION

Meeting with buyers

⇩

Development of initial samples for the buyer

⇩

Development of print, embroidery and other surface ornamentation mock-ups

⇩

Costing of garment

⇩

Pattern making and grading with corrections

⇩

Making of fit sample, size set sample and its approval from buyer

⇩

Correction of fit samples according to the suggestion of the buyer

⇩

Approval of fabric swatches, trims, print, color, embroidery design

⇩

Production planning, material and line planning

⇩

Procuring and Placing order for fabric & Trims

⇩

Testing of the products (fabric & trims)

⇩

Analysis of approved sample

⇩

Pre-production meeting

1. Meeting with buyers

It is conducted for both buyers and designers. Buyers come with their design of a style and discuss the change to be incorporated for the bulk production. And designer of the manufacturing house come up with the latest designs and display their creativity to the buyer.

2. Development of initial samples for the buyer

In this stage after receiving buyer's instructions on the design or/and style initial samples are developed with available fabrics and trims.

3. Development of fabric sample, bit loom, print and embroidery artwork

Fabric is procured according to the buyer requirement. Lap-dip approval is very important process for the solid color lap. Until lap dip sample is approved merchants re-submit lap dips. When yarn dyed fabrics is used, merchants develop fabric sample with specified design, stripes or checks. These fabric samples called as Bit Loom. Other approvals such as print, embroidery and surface ornamentation and color approval are done.

4. Costing of garment (complete cost as well as manufacturing cost)

Cost sheets are prepared with details of raw material, labor and ancillary cost. Costing is important factor for the business. Future orders are based on this only. If cost is low one may get business but may not earn profit but if its cost is too high, then profit will be there but may not get enough orders

or loose order. Estimation of the price should be based on data of previous sales.

5. Pattern making, correction of pattern, pattern grading

Firstly pattern master prepares fit pattern, then adding buyer comments and rectification on fit sample re-develops pattern. Only after its approval pattern master grade pattern for specified sizes. Once order is ready for production they grade pattern for whole size range.

6. Fit sample, size set sample making and approval from buyer

Each sample is prepared strictly following the design, suggestions and recommendations. Samples are made in sampling department. These samples are then sent to buyer for further approvals.

7. Correction of fit samples

Correction is required in following condition:

i. if sample is not approved

ii. further work is recommended by buyer

iii. size is not accurate

iv. each and every specification not incorporated

Required correction are done and re-submitted to buyer.

8. Approval of fabric swatches, print colors, embroidery design

Like-wise fabric swatches with complete details about fibre, print, surface ornamentation are procured. Other accessories like lace, beads etc. are also procured and kept for approval. If approved, then only it goes to production.

9. Production planning, material planning and line planning

After above approvals planning from production to shipping is done. To start production on time and shipping the order on time planning is essential. Planning is also needed for material sourcing, production

capacity, line planning. Scheduling of jobs and responsibility is also defined at this stage.

10. Placing order

For fabrics, trims, accessories and packing materials final orders are placed.

11. Testing

Testing of fabrics and other raw materials is done. For bulk fabrics physical properties are being tested. This test can be done in in-house testing labs.

12. Study of approved sample

For work content, operation break down, critical operation and line setting. Also finding best ways for producing a garment most efficiently in the production stage.

13. Pre-production meeting

Once pre-production (PP) sample is approved and most of the trims are sourced, merchants or the production planning department conduct, pre-production meetings with production team, quality team and sourcing team. All important comments, procedures to be followed, dos and don'ts are discussed. Scheduling of PCD (planned cut date) and shipment date is announced to all teams.

Activities

Activity 1: Make a flow chart of pre-production operations in the apparel industry.

Material Required:

1. A-3 Chart sheet
2. Pen/pencil, markers, eraser
3. Ruler
4. Note book

Step by Step Procedure:

1. Visit a nearby small scale apparel industry.
2. List out production activity one by one in the note book.
3. Make a flow chart of activities in synchronize manner in the chart sheet.
4. Place the chart in classroom or practical lab.

Check Your Progress

A. Fill in the blanks:

1. Pre-production is the processes that are done before starting a _____.
2. Fabric is procured according to the _____ requirement.
3. Cost sheets are prepared with details of _____, labor and ancillary cost.
4. Samples are made in _____ department.

B. Arrange these activities in proper order: -

1. Correction of fit samples according to buyer comments
2. Pattern making, correction of pattern, pattern grading
3. Meeting with buyers
4. Testing
5. Costing of garment (complete cost as well as manufacturing cost)
6. Pre-production meeting
7. Development of initial samples for the buyer
8. Development of fabric sample, bit loom, print and embroidery
9. Fit sample, size set sample making and approval from buyer
10. Study of Approved sample
11. Production planning, Material planning and line planning
12. Placing order.

Questions:

1. Explain and draw the flow chart of pre- production operations.
2. Explain the importance of pre- production planning.

Session 3: New Attachments of Sewing Machine

The machine operator needs to be updated with the latest development in the machineries related to garment manufacturing. With the advance technology many new machines have been developed but they add to the cost and require working space too. So for many new features attachments have been developed which can be simply attached to the sewing machines. It is very much essential to know in detail about these attachments. These attachments not only help in making designs but also are time and money saving.

Attachments for sewing machine

Type: Gathering Foot

Purpose: For creating soft gathers in light weight fabrics

Function: The foot is raised from below behind the needle with an additional metal plate in front of the needle to produce gathers

Specification: Ruffler assists in producing gathers

Fig. 1.2 (a,b,c): Gathering foot

Type: ¼" Seam Foot

Purpose: Essential ¼" seam specially for patch work

Function: The guide on foot sew a perfect ¼" seam

Specification: This guide is useful wherever ¼" seam is required but the markings on needle plate cannot be used.

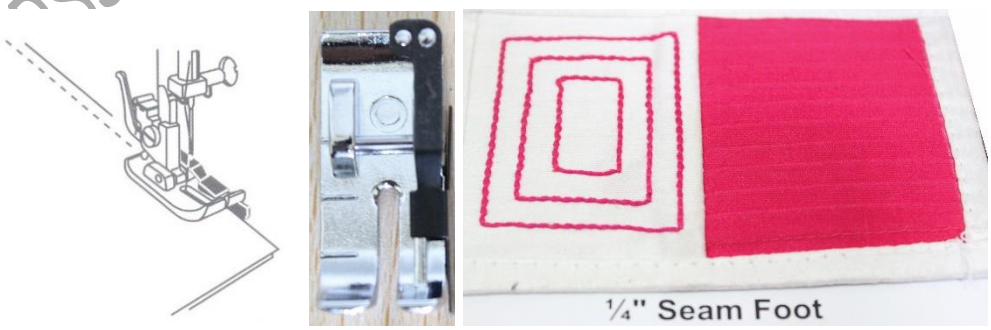


Fig. 1.3 (a,b,c): ¼" Seam foot

Type: Darning Foot

Purpose: For free hand embroidery and darning

Function: Ensure proper stitch formation and minimize missed stitches and puckering.

Specification: Beneficial to learners learning to do free hand embroidery

Fig. 1.4 (a,b,c): Darning foot

Type: Binder Foot

Purpose: To stitch pre-folded bias binding tape or bias tape

Function: Supplied with a small hollow funnel like structure to fold the binding over the fabric edge before it reaches the needle. It can be used in combination with either zigzag, straight or decorative stitches

Specification: 10mm to 14 mm bias tape can be used.

Fig. 1.5 (a,b,c): Binder foot

Type: 3-Way Cording Foot

Purpose: Holding 1,2 or 3 fine cords or threads

Function: With the perfect positioning the designs can be made easily.

Specification: A variety of stitches can be sewn over the cords. These can be couched onto base fabrics saving lot of time.

Fig. 1.6 (a,b,c): 3-Way cording foot

Type: Pin tucking foot

Purpose: Used with a 2mm needle to create multiple rows of pin tucks

Function: Pin tucking on different types of material can be done

Specification: The grooves below the foot. This helps in stitching several evenly-spaced parallel rows.

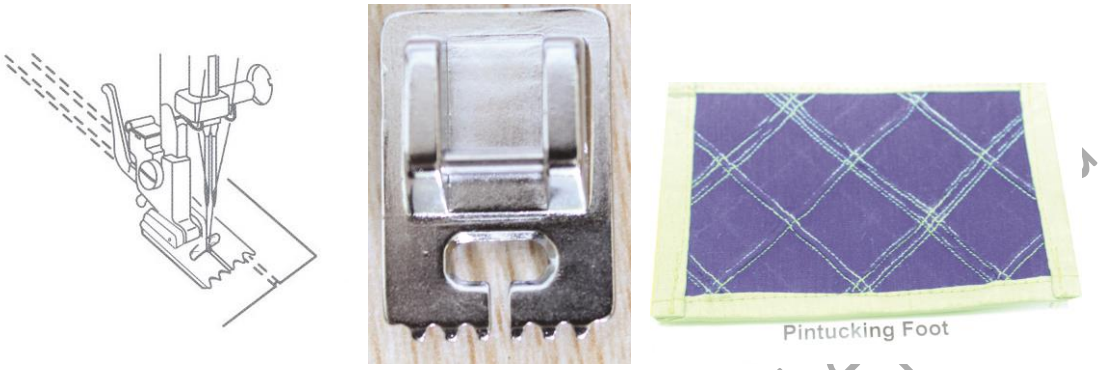


Fig. 1.7 (a,b,c): Pin tucking foot

Type: Beading Foot

Purpose: Making light work of sewing on beads and pearls

Function: There are two feet in the set: a narrow groove foot for beads up to 2mm in diameter and wide groove foot for beads 2.5-4 mm in diameter

Specification: Useful for all types of garments from bridal and evening wear to casual wear.

Fig. 1.8 (a,b,c): Beading foot

Type: Ribbon/sequin foot

Purpose: To attach ribbons and even sequins

Function: Foot with guides holds ribbon or sequins in place for even feeding

Specification: In addition to ribbon attachment. To make an easy and functional drawstring a wide ladder stitch can also be used with narrow ribbon.

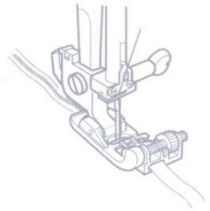


Fig. 1.9 (a,b,c): Ribbon/sequin foot

Type: Piping Foot

Purpose: To make piping cords

Function: It is designed with two grooves on the underside to holds and cover the cord when making piping tape. It can also be used for attaching piping

Specification: Maximum cord size is 5mm.

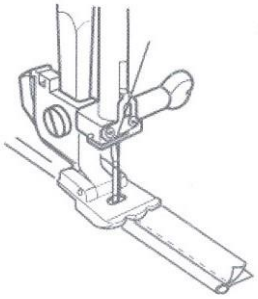


Fig. 1.10 (a,b,c): Piping Foot

Type: Ruffler Foot

Purpose: To make ruffles in one row of stitching

Function: It allows fabric to be ruffled or pleated quickly and easily. It also has the capability to vary the sizes of ruffles and pleats.

Specification: Its innovative design makes it very easy to use.

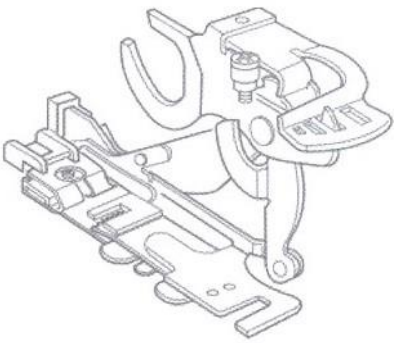


Fig. 1.11 (a,b,c): Ruffler foot

Activities

ACTIVITY 1: Prepare a collage of different attachments on sewing machine.

Material Required:

1. Chart sheet
2. Markers, pencil, eraser
3. Ruler
4. Scissor
5. Glue
6. Pictures of different attachments of sewing machine

Step- By- Step Procedure:

1. Collect the pictures of different attachments of specialized sewing machine.
2. Cut the pictures very neatly with scissors.
3. Paste the pictures and prepare a collage.
4. Label them.

ACTIVITY 2: Prepare a prototype sample file of samples prepared using specialized attachments.

Material Required:

1. Fabric sample (7”x7”)
2. New attachments for specific purpose

3. Needle and thread.
4. Scissor
5. Glue
6. Practical file

Step- By- Step Procedure:

1. Sewing practice with attachments on machine by threading the thread as mentioned above in the session.
2. Identify the specific purpose of each attachment.
3. Prepare samples with each attachment.
4. Attach the sample in practical file.
5. Label them.
6. Collect pictures of garment in which these feature is used and paste in practical file.

Check Your Progress

A. Fill in the blanks:

1. _____ attachment is used for bias binding/piping.
2. Ruffles can be made by _____ attachment.
3. For free hand embroidery and darning, _____ foot is used.

B. Questions:

1. Enlist different attachment for sewing machine.
2. State the purpose and characteristics of each of the above attachment.
3. Explain the end use of each attachment with the help of diagram.

Module 2	Feed off Arm and Bar Tack Machines

Module Overview

Feed off arm and bartack machines are valuable and important machines of garment industry. These machines are helpful for fast working and quality production. These machines are manufactured by various brands. In comparison to lock stitch/ over-lock machines, these are costlier and so this is the reason, we cannot find them in small and micro industries. An operator of these machines can earn better than normal machine operator. In this unit, the parts and operating process of both these machines are explained in detail.

Learning Outcomes
After Completing This Module, You Will Be Able To: • Demonstrate operationalization of Feed off the arm machine • Demonstrate operationalization of bar-tack machine
Module Structure
Session 1: Importance of Feed off Arm Machine
Session 2: Bar Tack Machine

Session 1: Importance of Feed Off arm Machine

Feed off arm machine is actually a chain stitch machine. By this machine, stitch can be produced on heavy fabrics, like denim or canvas. It has the opportunity of stitching by folding the fabrics.

This type of machine is available in variation like:

i. 2-needle, double chain stitch

ii. 3-needle, double chain stitch

This type of machine cannot be used for normal purpose. It is a very expensive machine and is used for mainly sewing medium- to heavy-weight materials like jeans, denim jackets, double stitching pants, work uniforms etc.

Fig. 2.1: Feed off arm machine

DIFFERENT PARTS OF FEED OFF ARM SEWING MACHINE

Needle: It is a very fine slender shaped piece of metal with a point at one end and a hole or eye for thread at the other. Needle is used to form a stitch in the fabric.

Take up Lever: The take up lever is used in threading the sewing machine and to keep the thread tension at the optimum level. If the take up lever is threaded wrongly, the thread will knot up and trapped in the machine.

Tension Disc: The two concave discs put together with the convex sides facing each other. The thread passes between the two. The tension of the thread is adjusted by a spring and nut which increases or decreases pressure.

Thread Guide: It holds the thread in position from the spool to the needle.

Presser Foot: The presser foot puts pressure on the fabric to keep it going smoothly along and prevent any wrinkles that could mess up the stitch.

Spool Pin: The main function of spool pin is to hold the spool of thread.

Stitch Setting Board: To control the stitches at sewing machines as well as size of the stitch, type of the stitch and number of stitches also it is used to monitor the current work position of the machine.

Fig. 2.2 Parts of feed off arm machine

Threading of Feed off Arm Machine

As this machine is having two needles and two loopers total four threads run to complete a stitch. Two threads are used for loopers and two threads are used for needles. For looper following steps are required:

Step-1

Keep all the four thread rolls in thread stand

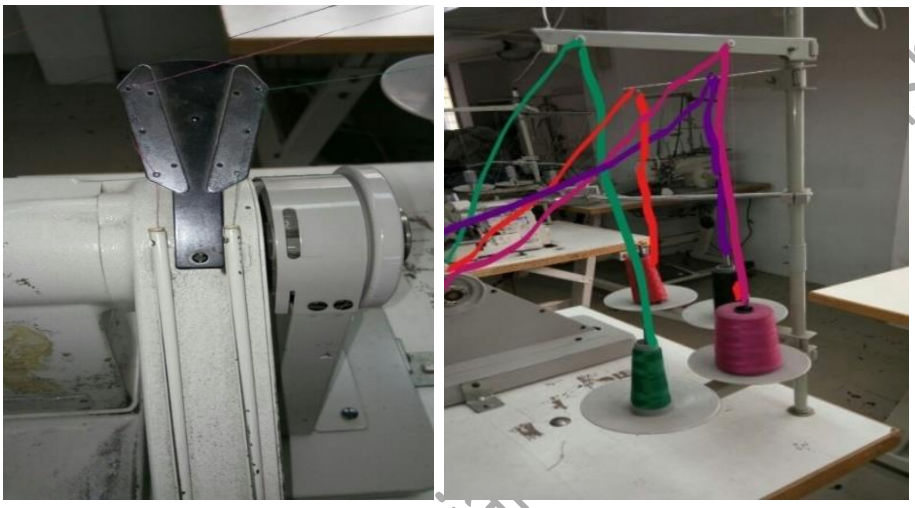


Fig. 2.3(a): Step-1

Step-2

As per above picture pass thread through looper

Fig. 2.3(c): Step-2

Step-3

Pass the thread through the thread guides as shown in picture

Fig. 2.3 (d): Step-3

Step-4

Pass the thread through thread guide

Fig. 2.3 (e): Step-4

Step-6

Fig. 2.3 (f): Step-6

Step-7

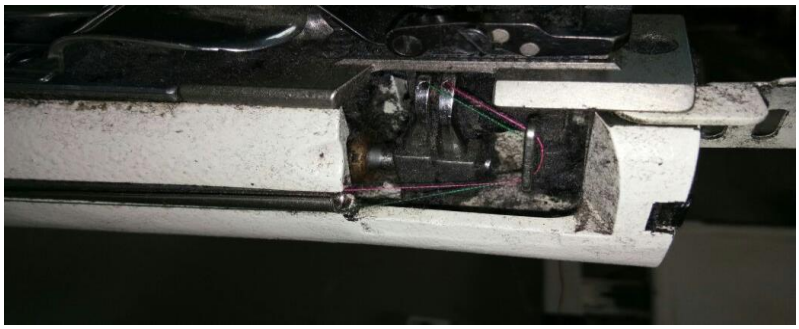


Fig. 2.3 (g): Step-7

Step-8

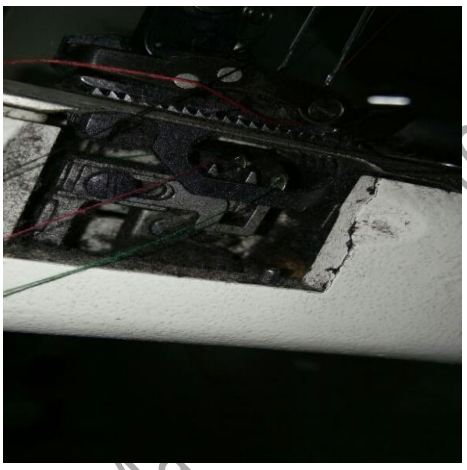


Fig. 2.3 (h): Step-8

Fig. 2.3 (Step 1-8) Looper threading of feed off arm machine

NEEDLE THREADING OF FEED OFF ARM MACHINE

Step-1

Fig. 2.4 (a): Step-1

Step-2

Pass another two threads from thread guide

Fig. 2.4 (b): Step-2

Step-3

Pass threads through tension disc

Fig. 2.4 (c): Step-3

Step-4

Pass threads through thread guide

Fig. 2.4 (d): Step-4

Step-5

Fig. 2.4 (e): Step-5

Step-6

And finally pass through needle

Fig. 2.4 (f): Step-6

Fig.2.4 (Step 1-6) Needle threading of feed off arm machine

OPERATIVE STEPS OF FEED OFF ARM MACHINE

1. Connect the plug to the switch board by checking to the type of voltage which suits the motor.
2. Carry on the process of threading for stitching.
3. Set the looper as per requirement

4. Set the required specification in the control panel.
5. Before running the machine check for needle guard and pedal mat.
6. Refer the stitch as per the requirement
7. Proceed the stitch area of the original garment

Table 2.1: Salient Features of Feed off Arm Machine

Sr. No.	Features	Type of machines	
		2- Needle, Double Chain Stitch	**3- Needle, Double Chain Stitch**
1	Stitch type	2-Needle - 4 thread	3-Needle - 6 thread
2	Speed	5,000-6,000 stitch/min	6,000-7,000 stitch/min
3	Length of stitch	1.0-4.0 mm	2.0-3.6 mm
4	Presser foot	By knee: 10mm	By knee: 9mm
5	Salient features	Gives accurate stitching performance and durable finished seams which are necessary in the chain stitching process. The high-quality sewing is attained with a higher degree of consistency with the unique looper mechanism. This machine is best suited for sewing jeans & double stitching pant	Smooth, efficient feeding of extra heavy weight upto 16-Ply and 14 oz denim used for seaming inside seams. The machine can be used for work uniforms, lap seaming jeans, denim jackets made of heavy weight materials. Yoke part up to 16-layered in hip seaming can be sewn efficiently. Best suited for medium- to heavy-weight materials.

Activities

ACTIVITY 1: Prepare a collage on looper and needle threading steps of feed off arm machine.

Material Required:

1. Chart sheet
2. Markers, pencil, eraser
3. Ruler
4. Pictures of looper & needle threading steps of feed off arm machine
5. Scissors
6. Glue

Step- By- Step Procedure:

1. Collect the pictures of looper & needle threading steps of feed off arm machine.
2. Cut the pictures very neatly and prepare a collage
3. Label them
4. Place the collage in classroom/practical lab.

ACTIVITY 2: Prepare a prototype sample file of samples done on feed off arm machine.

Material Required:

1. Fabric sample
2. Feed off arm machine
3. Needle & thread
4. Scissors
5. Glue
6. Practical file

Step- By- Step Procedure:

1. Sewing practice on feed off arm machine by threading the thread as mentioned above in the session.
2. Finish the sample and paste in practical file.

3. Label them.
4. Collect pictures of garment in which feed off arm machine is used and paste in practical file.

Check Your Progress

A. Fill in the blanks:

1. As feed off arm machine has two needles and two loopers, so total _____ threads run to complete a stitch.
2. Feed of the arm machine is actually a _____ _____ machine.
3. _____ _____ holds the thread in position from the spool to the needle.

B. Questions:

1. Explain the steps of threading the looper and needle of feed off arm machine.
2. Explain the operating process of feed off arm machine.
3. Explain the parts of feed off arm machine.

Session 2: Bar-Tack Machine

Bar-tacking is a type of stitching used by the fabric and textile industries to strengthen stress point in clothing, sporting equipment, uniforms. The bar-tack stitch is a tight zigzag pattern repeated perpendicularly. It makes sewn products stronger and resistant to tears or rips in the seams. Stress points are those points or the areas where garment will cause strain on the seams or fasteners.

Fig. 2.5: Bar-tacking machine

Importance and Use of Bar-tack machine

Mainly it is used for making belt loop, on pocket ending and closing the ends of buttonholes to give more strength. Through this machine an operator can make loops and give strength to pocket ends.

PARTS OF BARTACK SEWING MACHINE

Needle: It is a very fine slender piece of metal with a point at one end and a hole or eye for thread at the other. Needle is used to form a stitch in the garments.

Take Up Lever: The take up lever is used for threading in sewing machine and to keep the thread tension at the optimum level. If the take up lever is threaded wrongly, then thread will knot up and trapped in the machine.

Tension Disc: The two concave discs put together with the convex sides facing each other. The thread passes between the two. The tension of the thread is adjusted by a spring and nut which increases or decreases pressure.

Bobbin Winder: Bobbin winders are used to wind thread onto the empty bobbin. Bobbin winders can be found at the top, front or end of the machine.

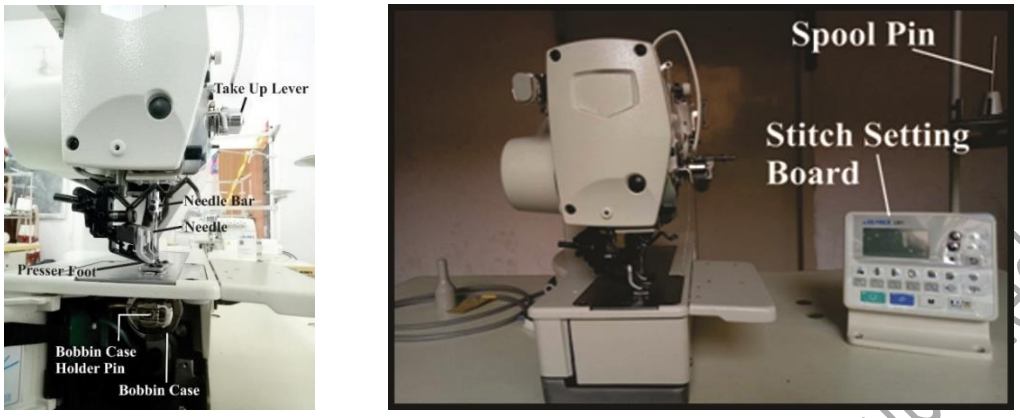


Fig. 2.6 (a,b): Parts of bar-tacking machine

Thread Guide: It holds the thread in position from the spool to the needle.

Presser Foot: The presser foot puts pressure on the fabric to pass it smoothly and prevent any wrinkles that could mess up the stitch.

Spool Pin: The main function of spool pin is to hold the spool of thread.

Stitch Setting Board: To control the stitches at sewing machines as well as size of the stitch, type of the stitch and number of stitches also it is used to monitor the current work position of the machine.

STEPS OF THREADING

STEP-1

Keep two thread rolls in thread discs

Fig. 2.7 (a): Step-1

STEP-2

Pass thread through tension disc

Fig. 2.7 (b): Step-2

STEP-3 Pass thread through thread guide as per below picture

Fig. 2.7 (c): Step-3

STEP-4

Pass thread through thread guides as per below picture

Fig. 2.7 (d): Step-4

STEP-5

Follow picture and move thread accordingly

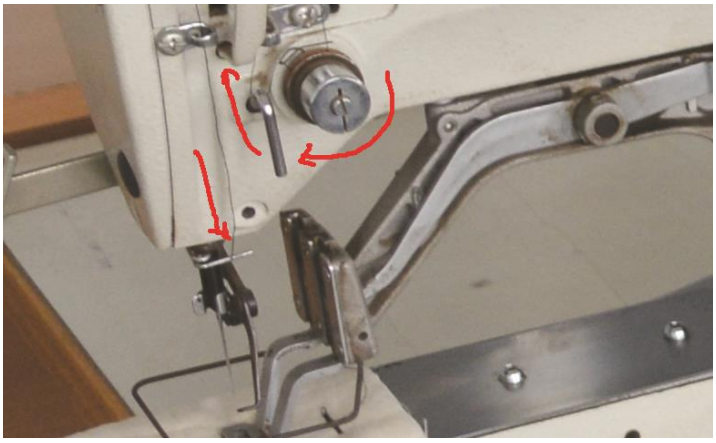


Fig. 2.7 (e): Step-5

STEP-6

Move thread through thread guide

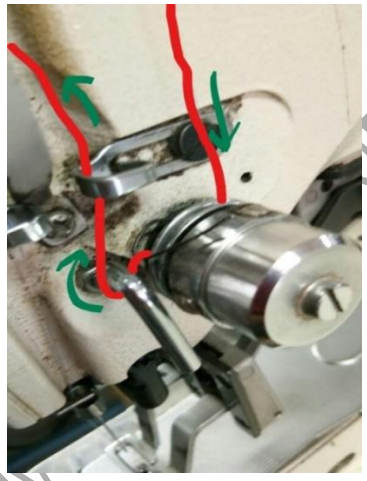


Fig. 2.7 (f): Step-6

STEP-7

Pass thread through thread bar

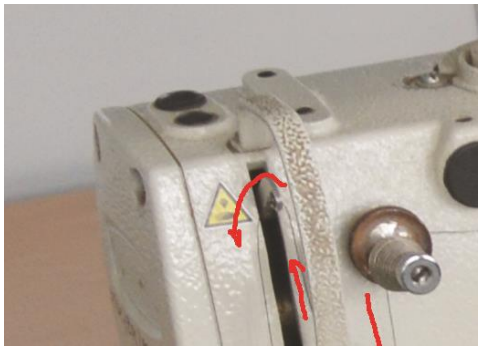


Fig. 2.7 (g): Step-7

STEP-8

Pass the thread from needle

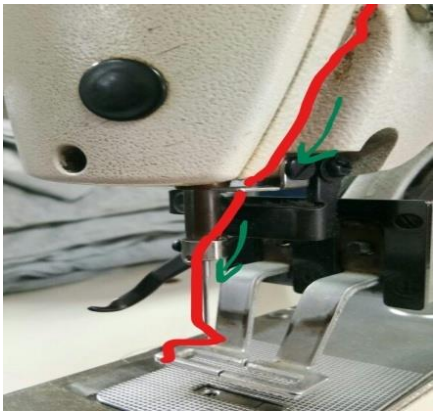


Fig. 2.7 (h): Step-8

Fig. 2.7 (Step 1-8): Threading of bar-tacking machine

OPERATING STEPS OF BARTACK MACHINE

Before operating a bar-tack machine, some technical adjustments which are to be taught are given below:

1. Basic machine practice
2. Technical specification
3. Installation of needle
4. Needle bar height adjustment

1. Basic machine practice: Demonstrate the adjustment then ask operators to practice on the machine.
2. Technical specification: Use the instructional manual given by the machinery supplier during session.
3. Installation of needle: Make sure, all the operators are able to understand the process of installing a needle.
4. Needle bar height adjustment: Proper adjustment practice is required. Practice of sewing on machine is also necessary.

Steps of Operating:

1. Connect the plug to the switch board by checking to the type of voltage which suits the motor.
2. Carry on the process of threading for stitching.
3. Sit in the proper posture and switch the machine on.
4. Now the threading is to be done for bobbin winder.
5. Fix the bobbin on the bobbin winder and do the thread winding.
6. Take the bobbin out of the bobbin winder and fix it to the bobbin case and place it in the bobbin case holder.

7. Set the required specification length & width of bar tacking, stitch tightness and speed etc. in the control panel.
8. Before running the machine check for needle guard and pedal mat.
9. Proceed the stitch in the marked area of the original garment.

Advantages of Bar-Tack Machines

1. In this machines browsing and editing of data can be carried out on the application software which helps in quick style change.

2. The prevention of shorter-thread remaining functions gives soft and smooth feeling on the bar-taking sections where there is direct skin contacts e.g. Undergarments and tank tops.

3. The machine's starting, stopping, thread-trimming and automatic presser lifting speeds significantly shorten total cycle time.

4. The sewing size can be easily changed.

5. A desired pattern can be changed with single-key operation for normally used patterns.

Table2.2: Advanced Features of Bar-tack Machines

Features	Specifications
Application	Standard, Heavy weight, Knitted materials
Sewing speed	2700- 3,200STI/min
Sewing area	30mm (L)×40mm (W)
Stitch length	0.1 to10mm (0.1mm step)
Lift of the work clamp	Standard 14mm (17mm when the reverse-rotation needle-up function)
Hook	Standard shuttle hook / Large shuttle hook
Memory Capacity	Up to 20,000 stitches

Features	Specifications
Max. number of standard patterns	51 patterns
Number of data that can be input	Max.200 patterns

Activities

ACTIVITY 1: Prepare a chart on threading steps of bar-tack machine.

Material Required:

1. Chart sheet
2. Markers, pens, pencil
3. Eraser
4. Ruler
5. Picture of bar-tack machine

Step by step procedure:

1. Paste the picture of bar-tack machine in chart sheet.
2. Write down the threading process of bar-tack machine.
3. List out different parts of bar-tack machine.
4. Label them.

ACTIVITY 2: Prepare a prototype samples file of bar-tack machine.

Material Required:

1. Bar-tack machine
2. Fabric sample (7" x 7")
3. Needle, thread
4. Scissors
5. Pens, markers, pencil
6. Ruler
7. Glue

Step by step procedure:

1. Sewing practice on bar-tack machine on a fabric sample
2. Identify seam done by bar-tack machine
3. Prepare samples, finish them and paste in practical file
4. Label them
5. Collect pictures of garment in which bar-tack machine is used and paste in practical file

Check Your Progress

A. Fill in the blanks:

1. Bar-tack machine is used for making belt loop, on pocket ending- to give more strength, and closing the ends of _____.
2. _____ _____ board is used to control the stitches.
3. _____ ___ _____ is used for threading in sewing machine.

B. Questions:

1. Explain the threading steps of bar-tack machine.
2. Explain the operating process of bar-tack machine.
3. Explain the parts of bar-tack machine.

Module 3	Flat Lock Machine, Blind Stitch Machine, Finishing Machines and Other Equipment

Module Overview

The flat lock is the interlock machine and used on knit wear garments. The blind stitch machine is used for hemming and facing attaching and is very accurate in giving neat and finished look. Both these machines are important in garment production. Both of these machines are useful in finishing of garments while manufacturing of garments. These machines are extremely fast and efficient. The finishing equipment other than these are fusing and ironing which is also discussed here. The parts, operating procedure and sample making on these machines are the main part of this unit to make the students aware of their usage in garment manufacturing industries.

Learning Outcomes
After Completing This Module, You Will Be Able To: • Identify stitching process of flat lock machine • Identify operating system of blind stitch sewing machine • Identify and operate finishing machines and other Equipments
Module Structure
Session 1: Flat Lock Machine
Session 2: Blind Stitch Machine
Session 3: Finishing Machines and Equipment

Session 1: Flat Lock Machine

Flat lock machines are used for interlocking. A flat lock machine has 2 or 3 needles. It is mainly used in knit wear garments but can be used for other materials also. At the interlocking points top surface looks like parallel rows of straight stitching and the underside looks like loops, which 'covers' the turned down raw edge. The stitch is formed by needle passing through the material; inter looping on the underside and interlocking on the upper side. The most basic cover stitching involves folding over the hem of a flat piece of

fabric to the 'wrong' side and cover stitching from the right side, catching the hem underneath. Flat lock machines are specialized, high-speed machines. These machines are extremely fast and efficient.

Fig.3.1: Flat lock machine

They are available in two versions

1. Flatbed flat lock: It is used for main part of the garment.
2. Cylinder bed flat lock: It is used to hem the sleeve and bottoms of knit wear and cover stitch any part of the garment for the decorative purpose.

PARTS OF FLAT LOCK MACHINE

1. Thread Guide: It holds the thread in position from the spool to the needle. Also direct the thread to feed it through the machine without tangling and at the correct tension.
2. Eye guard: This is used for the protection of the eyes of the needle used for sewing purposes.
3. Thread Tension Spring Cap: The tension of the thread is adjusted by this cap, which increases or decreases pressure.
4. Feed Dog: This consists of a set of teeth fitted below the needle plate. It helps to move the cloth forward while sewing.
5. Needle: The needle carries the upper thread through the fabric to create a stitch. Specialty needles are available for specific stitching needs.
6. Oil Cap: The primary function of an oil cap is to seal the oil reservoir. A good oil caps in order to prevent leak or "blow by". A missing or defective oil cap can cause a loss of oil leading to machine damage.
7. Adjusting screw: Tighten and loosen this screw to controls the length of the stitch.
8. Presser arm: This is a part or bar holding/containing presser foot and presser foot release.

9. Presser Foot: It is fixed to the presser arm to hold the cloth firmly in position when lowered. It works with the feed dog to move fabric evenly through the machine.
10. Presser foot release: A lever attached to the presser arm for raising and lowering the presser foot. When the presser foot is lifted, the tension discs are disengaged, and the fabric will not feed through the machine

THREADING OF FLAT LOCK MACHINE

STEP-1

Place the thread cones on the bars

Fig.3.2 (a): Step-1

STEP-2

Pass the thread through the thread bar

Fig.3.2 (b): Step-2

STEP-3

Pass the threads through thread guide.

Fig.3.2 (c): Step-3

STEP-4

Pass the threads to the tension discs.

Fig.3.2 (d): Step-4

STEP-5

Pass though thread guides.

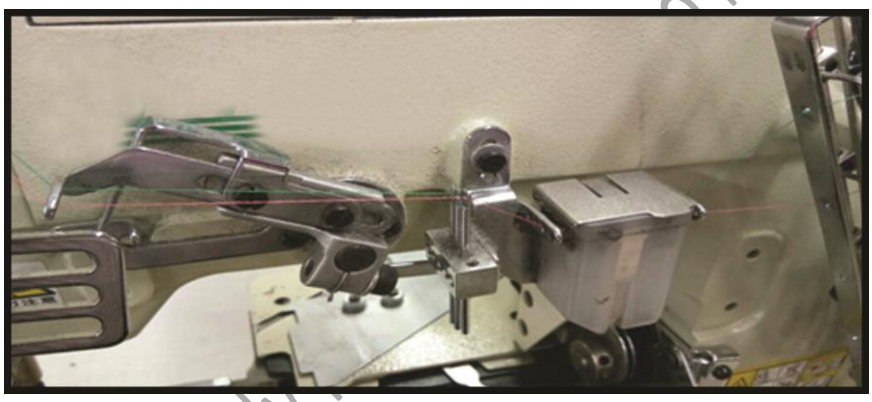


Fig.3.2 (e): Step-5

STEP-6

Pass the threads through thread takeup lever.

Fig.3.2 (f): Step-6

STEP-7

Pass the thread through needle.

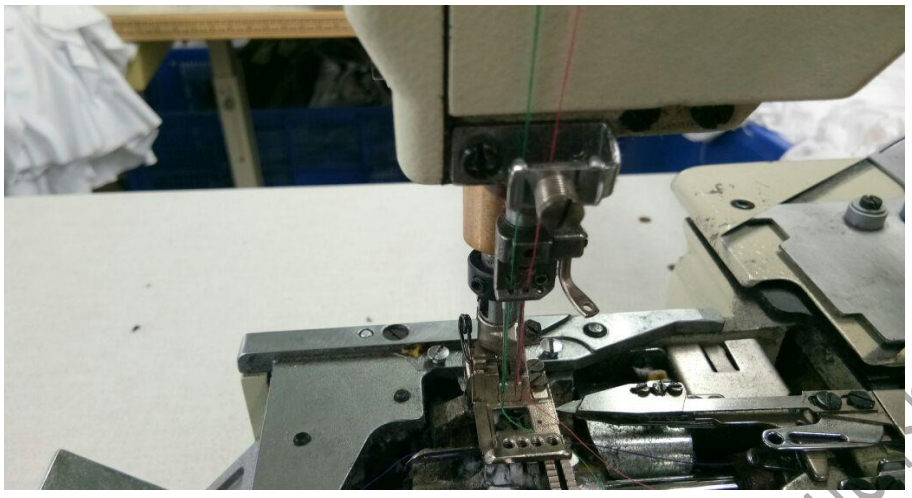


Fig.3.2 (g): Step-7

STEP-8

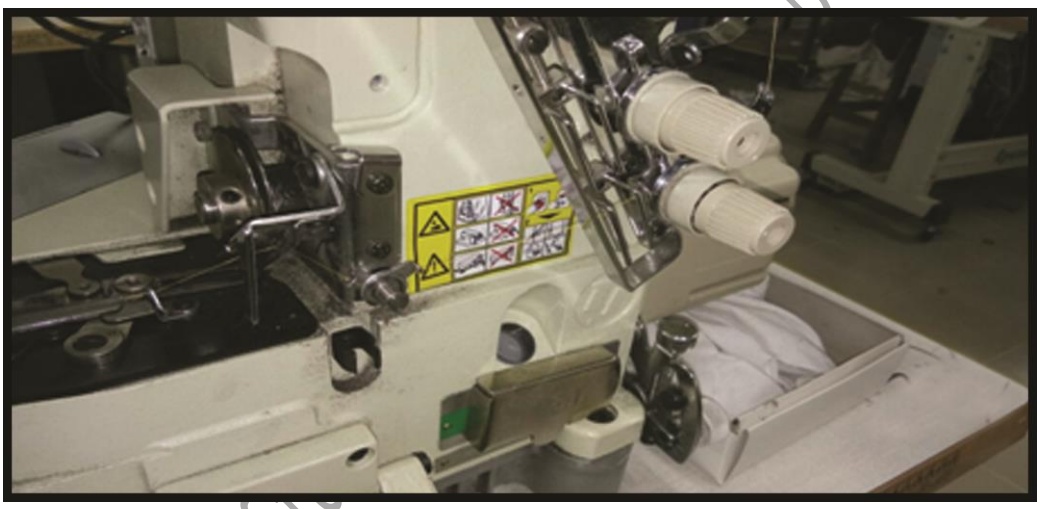


Fig.3.2 (h): Step-8

STEP-9

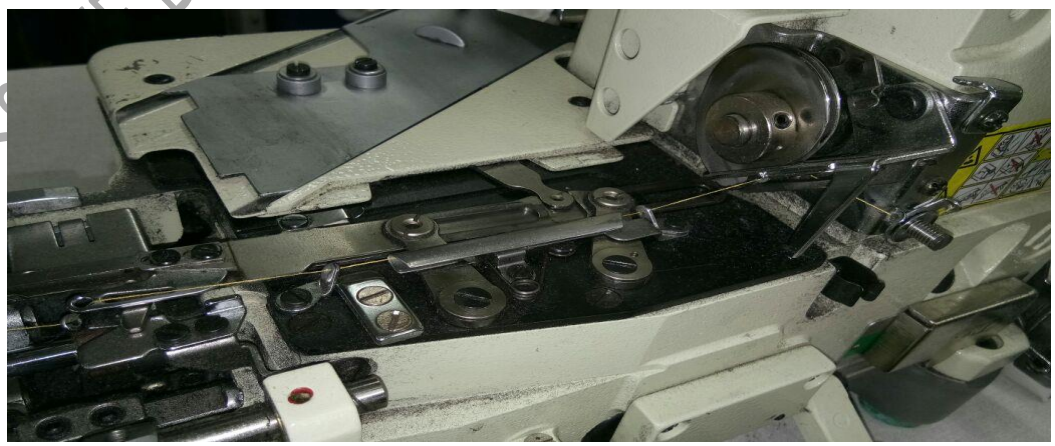


Fig.3.2 (i): Step-9

STEP-10

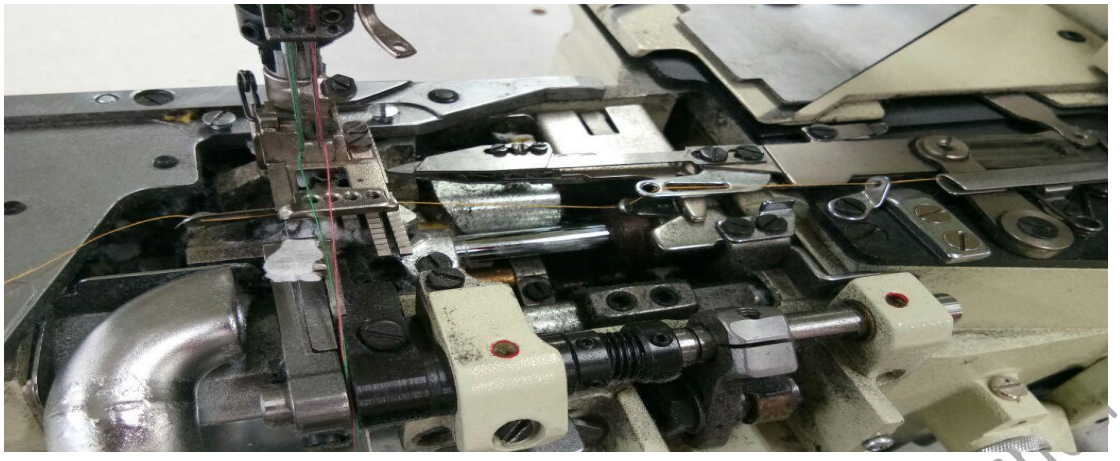


Fig.3.2 (j): Step-10

STEP-11

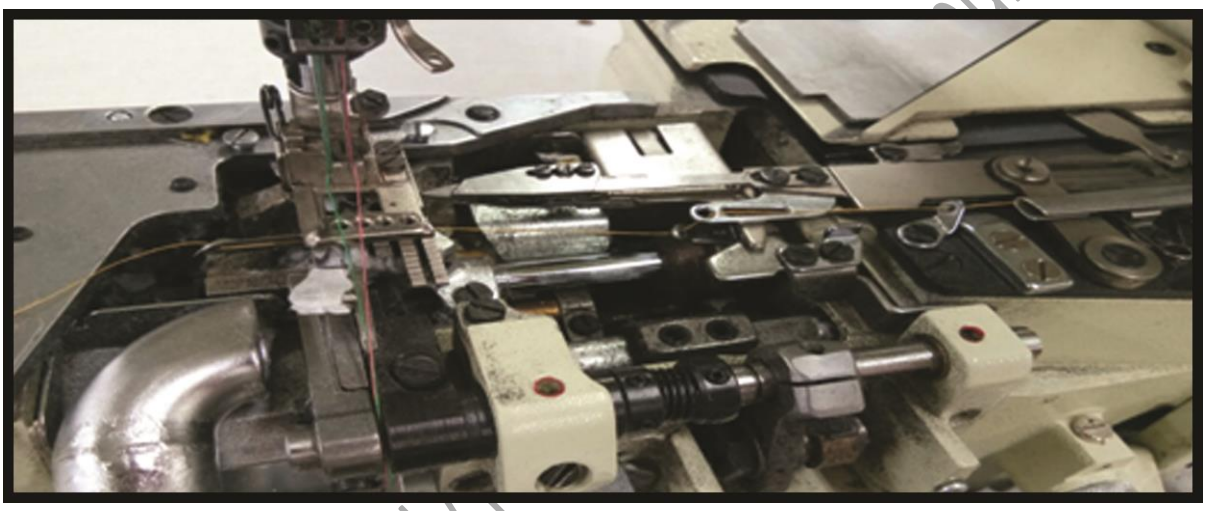


Fig.3.2 (k): Step-11

Fig. 3.2 (Step 1-11): Flat lock machine threading

OPERATING STEPS OF FLAT LOCK MACHINE

1. Connect the plug to the switch board by checking to the type of voltage which suits the motor.
2. Carry on the process of threading for stitching.
3. Set the looper as per requirement
4. Sit in the proper posture and switch the machine on.
5. Set the required specification length & width of flat locking/looping, stitch tightness and speed etc. in the control panel.
6. Before running the machine check for needle guard and pedal mat.
7. Keep fabric on the cylindrical bed and proceed the stitch in the marked area of the original garment.

Table No. 3.1 Advance features of flat lock machine

Features	Specifications
Type	Flat & cylinder bed
Sewing speed	2500- 6000 STI/min
Needle Size	9,11,14,16,18,20,21
Stitch length	1 to1.5 mm
Material	Mainly Knitted

Activities

ACTIVITY 1: Prepare a small dictionary (20 words) terms related to flat lock machine.

Material Required:

1. A3 chart sheet
2. Pen/Pencils
3. Ruler
4. Eraser
5. Scissors

Step by Step Procedure:

1. To prepare a small dictionary cut the chart sheet
2. Identify 20 words for dictionary terms related to flat lock machine
3. Write words in dictionary and the meaning of the word.

ACTIVITY 2: Prepare samples through flat lock machine.

Material Required:

1. Flat lock machine
2. Fabric sample (7' x 7")

3. Needle, thread
4. Scissors
5. Pens, markers, pencil
6. Ruler
7. Glue
8. Practical file

Step by step procedure:

1. Sewing practice on flat lock machine.
2. Identify seam done by flat lock machine.
3. Make samples and paste in file.
4. Label them
5. Collect pictures of garment in which flat lock machine is used and paste in practical file.

Check Your Progress

A. Fill in the blanks:

1. Flat lock machine is used in _____ wear garments.
2. _____ is used for the protection of the eyes while sewing.
3. _____ bed flat lock is used to hem the sleeve and bottoms of knit wear.

B. Questions:

1. Explain the threading steps of flat lock machine.
2. Explain the operating process of flat lock machine.
3. Explain the parts of flat lock machine.

Session 2: Blind Stitch Machine

Blind stitch machine is used for stitching of knitted garments. Here on the right side of the garment stitch is invisible. Alternatively, the machine could be set to skip a stitch to pick up the fabric on alternate stitches, but this setting affects the stability of the stitches.

This machine saves time when it comes to blind hemming a garment. After changing special blind hem foot in the machine and blind hem stitch is selected, it can create a nice blind hem but this task needs a lot of practice to make a perfect invisible hem to your garment.

Fig.3.3: Blind stitch machine

The blind stitch machine creates the stitches by the movement of needle side to side rather than up and down as the needle movement of a conventional sewing machine. It is the only machine that can create stitch in this way. One or two threads can be used. Curved needle mainly used for this machine. Stitches are not seen on face side of the fabric. Stitches are more secure if two threads are used. Mainly it is used for hemming and facing attaching. The fabric is kept between two small oblong discs which run lengthwise and perform very much like sewing machine feed dogs. There is a small lever at the side of the machine which holds the fabric in place by pushing the garment. As the needle sweeps from side to side the fabric is graced and caught creating a visible stitch on face side and a blind stitch (invisible) on the reverse side.

Parts of Blind Stitch Machine:

Spool pin: It is fitted on top of the arm of machine to hold the reel.

Thread guide: It keeps the thread in position from the spool to the needle.

Tension disc: The two concave discs kept together with the convex sides facing each other. The thread passes between the two. The tension of the thread is adjusted by a small spring and nut which increases or decreases pressure according to the requirement.

Take up lever: It is a lever fitted to the body of the arm of machine. It's up and down motion feeds the thread to the needle and tightens the loops formed by the shuttle.

Stitch regulator: This controls/regulates the length of the stitches.

Spool pin for bobbin winding: At the time of bobbin winding spool of thread is placed on this.

Fly Wheel: When it is revolve, it works the mechanism of the motion.

Bobbin winder: It is used for winding thread on the bobbin.

Clutch or Thumb Screw: It is positioned in the centre of the fly wheel and it engages and disengages the stitching mechanism.

Needle bar: It is a metal rod to hold the needle at one end with a clamp. Its main function is to give motion to the needle.

Presser foot: It is fixed to the presser bar to hold the fabric firmly in position when it is lowered.

Feed dog: This is made of a set of teeth fitted under the needle plate. It helps to move the cloth forward while sewing.

Needle Plate or Throat Plate: A semi-circular disc with a hole to permit the needle to pass through it.

Slide Plate: A rectangular plate, which allows the removal of the bobbin case without lifting the machine.

Bobbin case: This moves into position to catch the top thread and form the stitch as the needle is lowered into the bobbin chamber.

Presser foot lifter: A lever attached to the presser bar for lifting and lowering the presser foot.

OPERATING STEPS OF BLIND STITCH MACHINE:

1. Attach the blind seam foot.
2. Connect the plug to the switch board by checking to the type of voltage which suits the motor.
3. Carry on the process of threading for stitching.
4. Sit in the proper posture and switch the machine on.

5. Now the threading is to be done for bobbin winder.
6. Fix the bobbin on the bobbin winder and do the thread winding.
7. Take the bobbin out of the bobbin winder and fix it to the bobbin case and place it in the bobbin case holder.
8. Set the required specification length & width of seam, stitch tightness and speed etc.
9. Before running the machine check for needle guard and pedal mat.
10. Proceed the stitch in the specified area of the original garment.

Activities

ACTIVITY 1: Prepare a chart on parts of blind stitch machine.

Material Required:

1. Chart sheet
2. Markers, pens, pencil
3. Eraser and ruler
4. Scissors
5. Pictures of parts of blind stitch machine
6. Glue

Step by step procedure:

1. Collect the pictures of blind stitch machine.
2. Cut the pictures neatly.
3. Paste the picture on chart sheet.
4. List out different parts of blind stitch machine.
5. Label them
6. Place the chart in classroom/ practical lab

ACTIVITY 2: Prepare a sample file.

Material Required:

1. Blind stitch machine
2. Fabric sample (7"x7")
3. Needle and thread

4. Scissors
5. Practical file
6. Pens, markers, pencil
7. Ruler
8. Glue

Step by step procedure:

1. Sewing practice on blind stitch machine.
2. Identify seam done by blind stitch machine.
3. Prepare samples and paste in file.
4. Label them
5. Collect pictures of garment in which blind stitch machine is used and paste in practical file.

Check Your Progress

A. Fill in the blanks:

1. _____ needle mainly used for blind stitch machine.
2. The two concave discs of tension disc are put together with the _____ sides facing each other.
3. Mainly blind stitch machine used for _____ and _____ attaching.

B. Questions:

1. Explain the operating process of blind stitch machine.
2. Explain the parts of blind stitch machine.

Session 3: Finishing Machines and Other Equipment

The garment production unit not only deals with the specialized sewing machine but also other finishing machines and equipment. For final finishing of garments according to the requirement many finishing machines are available. This session deals with the details of those machines and equipment.

Welt Attachment Machine

Welt is a functional as well as decorative feature of any garments. It can be described as a covered cord or strip of material applied to seam on a garment edge to cover or strengthen it. A "set-in" pocket is also finished and strengthened with "piping" or fabric "welts" along its length.

Welting is mainly used for pockets in formal pants, sport wear, uniforms, etc. The variation can be done in the pockets by use of different welting available commercially e.g. straight pocket, straight pockets with flaps, slant pocket, slant pocket with flaps.

The welting machine also has a specific application in the manufacturing of shoes. It is used for flexible shoes construction, dance shoes, ballerina shoes, and military shoes and in the reverse shoes construction.

For pocket welting commercially lock stitch pocket welting machines are used and is ideal for all segments of apparel industry. Range of available accessories make lock stitch machine capable for use of wide variety of applications. It is capable of sewing straight and slanted welts at a speed of 3000 stitch per minute. Earlier for welting, special attachments were attached to the sewing machines. Now a days specialized welting machine are also available as shown in figure below.

Fig 3.4: Welting machine

Parts of the machine

The machine has common parts as automatic sewing machines. The specialized parts of welting machines are as follows.

1. Drive Motor – This motor drive the machine parts by electrical power. In advanced machines energy loss is reduced to minimum. Due to saving of energy loss this machine is economical. Also the special feature of these machines is low operating noise which reduces the operator fatigue.

2. Machine head – In advanced machines semi dry head is used to avoid the staining of the garments.

3. Welt support – Support for long and wide welt is extended in advanced machines to sew large sized pockets.

4. Corner Knives– The corner knives cut the extra material. In advanced machines corner knives enabling easier adjustments.

OPERATING STEPS OF WELTING MACHINE:

1. Attach the welt attachment foot to the machine.
2. Connect the plug to the switch board by checking to the type of voltage which suits the motor.
3. Now the threading is to be done for bobbin winder.
4. Fix the bobbin on the bobbin winder and do the thread winding.
5. Set the required specification length & width of seam.
6. Before running the machine check for needle guard, pedal mat & knives.
7. Sit in the proper posture and switch the machine on.
8. Proceed the stitch in the specified area.

Table 3.1: Salient Features of Welting Machines

Features	Specifications
Stitch type	Parallel, slant & trapezoid
Sewing speed	1600 – 2200 RPM
Needle size	14, 16 , 18
Sewing pitch	1- 3 mm
Material	All material
Hook	Horizontal rotating hook
Stitch length setting	6 types
Needle gauge	Std.-9,10,12 / Special – 14 to 31.6

Fusing machine

Fusing machines are used for fusing process in garment manufacturing. Fusing is a very important method of finishing for garments.

The process where in the small components or whole part is fused with thermoplastic coated resin interlining is called fusing. It gives strength and stability while improving the shape and crease resistance to a garment. It also helps in improving the appearance of finished garment by strengthening design feature, maintaining the crisp and fresh look of the base fabric without much change in drape quality. In garment, fusing is done in waistbands, overlap, under lap, collars, facings, cuffs, pocket flaps. This process is done after material cutting and before the final operations in a cutting process.

Factors affecting fusing quality are:

- Temperature
- Time
- Pressure
- Peel strength
- Wash

Types and characteristics of fusing presses:

They can be classified into two according to the way they perform the work process:

i. discontinuous work process (flat) fusing presses and

ii. continuous work process fusing presses

Table 3.2: fusing machine

Sr. No.	Discontinuous work process	Continuous work process
1	It follows a sequential fusing process but separated from each other.	It enables an ongoing process by moving the components on a conveyor belt.
2	They are less productive and are suitable for small and medium production units.	They offer a higher level of productivity and are suitable for different power production units.
3	The discontinuous fusing press is flexible for a range of materials, needs low maintenance.	Because of the energy saving advantage continuous fusing presses are used more often.

Fig. 3.5: Discontinuous (flat-bed) fusing press

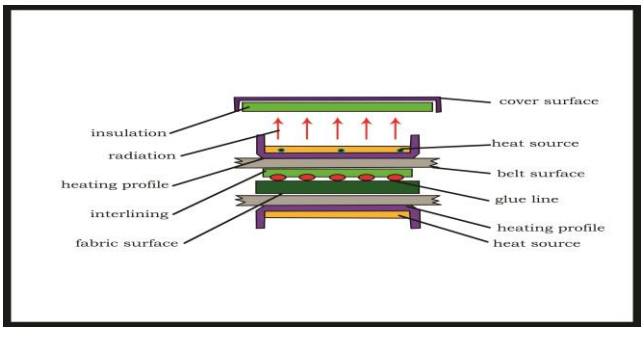


Fig. 3.6: Continuous fusing press.

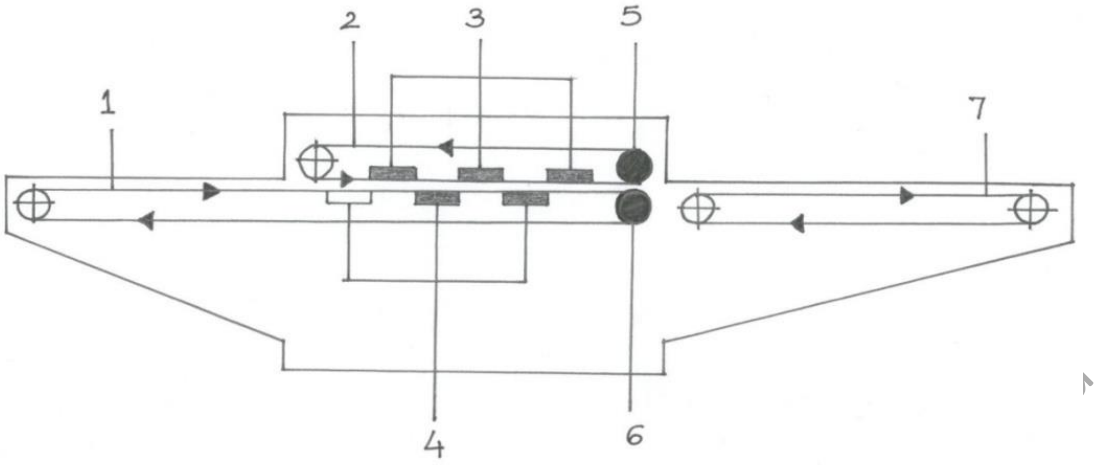


Fig.3.7: Continuous fusing process

1. Loading and feed (lower) conveyer belt
2. Upper conveyer belt
3. Upper heating zone;
4. Lower heating zone;
5. Pressure rolls;
7. Exit conveyer.

OPERATING STEPS OF FUSING MACHINE:

- The part of the fabric where fusing is to be done and the interlining is placed one over the other in the slot of the machine.
- Specified temperature and adequate pressure is applied.
- With the increase in temperature, the resin changes to viscous fluid.
- With adequate pressure, this molten resin adheres to the fibre in the fabric as well as in the interlining.
- Next process is cooling wherein a durable bond is formed between the base and interlining fabric.

Flow chart of the process

Spreading the part of garment to be fused

⇩

Placing of interlining on this surface

⇩

Applying required pressure and temperature

(Resin from interlining is transferred to the fabric)

⇩

Cooling

⇩

Fabric and interlining is attached

Methods of Fusing:

1. **Reverse fusing** –Fusing material is placed below the outer material and heat is applied
2. **Sandwich fusing** – Heat is applied from both top and bottom of the fusing material.
3. **Double fusing** – In a single process two types of interlining are fused.

Pressing:

This is the process which consist of application of heat, pressure and moisture to shape or crease the apparels and garments. The pressing process affects the final garment appearance and hence improves the garment looks.

Purpose of pressing:

- Remove the wrinkles, creases and crush marks.
- Make creases as per garment designs require it.
- Mould the garment as per the silhouette of the garment body.
- Ready the garments for next sewing operation.
- Refinish the garment after the production process finished.

Pressing parameters

The main parameters of the pressing are heat, pressure and moisture to give the fabric desired effect.

1. Heat – To soften the fibres and set the fabric in required shape. Temperature should be selected according to the type of fibres, yarns and fabrics.

2. Steam – It is easy & fast method of transmitting the heat to the fabric.

Steam and heat are necessary to release the fabric from tension and make the fabric flexible to get required shape.

3. Pressure – It is applied to change the form and increase the durability of the molding. Pressure is applied by steam or mechanical device.

4. Drying – after application of steam and pressure on the fabric, the garment panel or finished garment is dried and cooled; then the fabric will be return to its original moisture content and steady condition. This is done by removing the excess water from the fabric using vacuum action which also cools it at the same time.

5. Time – The time for the garment to expose to the steam, pressure and drying depends on the type of fabric to be pressed.

Pressing equipment used in apparel industry:

Many different equipment are available for the pressing or ironing of garments. This range includes the hand steam irons, sophisticated vertical front and back pressing robot, etc . The various equipment used for ironing or pressing are iron, steam presses, steam tunnel, steam air finisher pleating and permanent press.

Types of Pressing Equipment:

Hand irons:

In past, irons were heated using charcoal for pressing and ironing. Since the development of electric iron and steam iron, these are more widely used in industry and coal iron is rarely seen.

Types of iron used in apparel/garment:

1. Dry iron
2. Electric irons
3. Electric Steam iron

Dry Iron: In this iron charcoal is used to heat the below surface for ironing and pressing. There is no scope of steam generation in this so called as dry iron.

Electric irons: In this iron electrical coil is present which heated up by the use of electricity and bottom surface of the iron gets heated by this coil which is used for pressing of the garment.

Electric Steam Iron: These are same as electric iron but a special feature of steam generation using water is present in this. This type of iron is more efficient to remove creases in garments.

Fig. 3.8: Ironing

Iron table:

This is the platform on which one lays the garment for pressing. The main factor for the selection of an ironing table is the air flow through the garment to cool it and set it. Some types of ironing tables are listed below:

1. All purpose table
2. Trouser seam ironing table
3. Trouser leg ironing table
4. Blouse and shirt ironing table
5. Sleeve seam ironing table
6. Dress board ironing table
7. Jacket seam ironing table
8. Flat top ironing tables
9. Hip-bow ironing table
10. Concave ironing table
11. Convex ironing table
12. Curtain ironing table

Buck press or Steam press

This press consists of a static buck and a head closing onto it, thereby sandwiching the garment for pressing. This is consists of a frame housing and the buck which is in round shape for pressing different garments.

Fig. 3.9: Buck press/steam press

Steam is supplied to head and buck by a pipe system. Vacuum is developed to provide suction through the buck by a vacuum system. The garment to be pressed is placed between the bucks and then buck head closes and gets locked. After this steam is applied to the head to press the garment for specific time required as per type fabric or garment. Then head is released and by means of vacuum it is cooled and dried. Now the garment is moved for another part to be pressed. After completing the pressing of the all parts garment is hung on the hanger.

The different presses used for different parts of the garments mentioned below.

1. collar press
2. sleeve press
3. shoulder press
4. back and front press
5. collar master

Trouser pressing:

It includes garments, ranging from jeans, women's trousers, men's trousers including four pockets, and suit trousers. The trouser pressing includes two operations. The first operation is done for legging on a flat press to set and crease the legs. After this in the second operation topping in a series of lays around the top of the trouser.

Fig. 3.10: Machine for trouser

Double legger-pressing machine:

This machine is used for pressing trousers. In this machine both the legs are pressed simultaneously. These machines having vertically acting heads, carousels and microprocessor controls. In this machine, heat resistant silicone foam is used for covering bucks of steam presses. The tables used with irons and vacuum boards and the outside are covered with a woven polyester. Instead of polyester in some cases nylon is used.

Carousel press:

It is a new development in pressing operation. In this pair of bucks is provided which is rotating between operator and head. The head is single and double based on the bucks. In this press, scissor action and vertical acting heads are used.

Fig:3.11 Carousel press

Steam finisher:

It is known as a dolly press or a form press. In this compressed air system is used. The frame for a steam distribution system and a pressing form is made of a canvas bag in the suitable silhouette of the garment to be pressed.

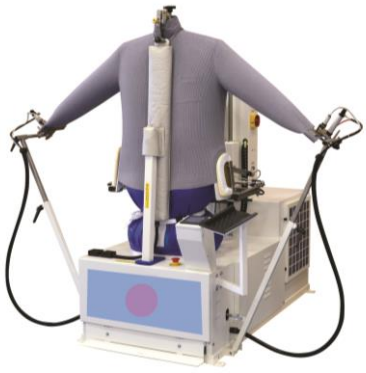


Fig.3.12: Steam finisher

Tunnel finisher:

This is used for finishing knitted garments. It can be used for manmade fibre garments and blends of manmade. In this garment finishing process, pressure is not applied to the garment. In this process the garments are kept on hangers and fed through the cabinet by means of motorized rail. The garments pass through sections containing superheated steam and dried by blowing air. In some type of machines garments are loaded on frames and passed through the tunnel on a conveyor.

Fig.3.13: Tunnel finisher

Creasing machines:

These machines are used to fold and press the edges of garment components such as pockets or cuffs to prepare them for easy sewing. To create creases and folds blades are used. The Garment part is placed on a die with blades aiding in forming creases around it and pressure is exerted on garment during pressing cycle. Creasing is actually operation under pressing machine.

Pleating:

This is the process of developing or creating pleats in the garments. These pleats can also be called as fold. This fold or pleats formed during stitching by doubling fabric and securing it in place. This pleat can be introduced in pressing by developing set of creases in the garment and setting it by pressing. The pleats are mostly in geometrical pattern. Pressure, moisture and heat are used to develop pleating.

There are two types of machine use for pleating.

1. One blade machine – In this machine by the action of the blades pleat is formed.
2. Rotary machine – In this, roller are fitted with complimentary dies. In one blade machine pleats are formed by the action of blades and then set by heat and pressure when they pass under a pair of rollers and the second type is a rotary machine in which the rollers are fitted with complimentary dies. Hand pleating, crystal pleating, fan-shaped pleats and box pleats are some of the examples shown in below figure.

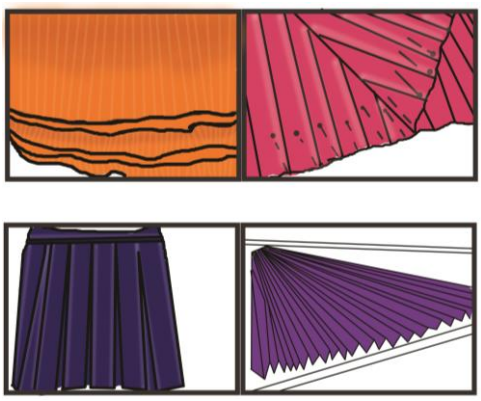


Fig. 3.14: Pleating samples

Activities

ACTIVITY 1: Prepare charts on parts of welt attachment machine, fusing machine and pressing machine.

Material Required:

1. Chart sheet
2. Markers, pens, pencil, eraser
3. Ruler
4. Pictures of welt attachment machine, fusing machine and pressing machine
5. Scissors
6. Glue

Step by step procedure:

1. Cut the pictures very neatly and paste in chart sheet.
2. Label them
3. List out different types welt attachment, fusing and pressing machines with its characteristics features.
4. Place the chart in classroom or practical lab.

ACTIVITY 2: Prepare a sample file.

Material Required:

1. Welt attachment, fusing and pressing machines
2. Fabric sample (7”x7”)

3. Needle and thread
3. Scissors
4. Practical file
5. Pens, markers, pencil
6. Ruler
7. Glue

Step by step procedure:

1. Sewing practice on welt attachment, fusing and pressing machines.
2. Identify seam done by welt attachment, fusing and pressing machines.
3. Collect pictures of garment in which welt attachment, fusing and pressing machines is used.
4. Prepare samples on these machines.
5. Finish the sample and paste in practical file
6. Label them

Check Your Progress

A. Fill in the blanks:

1. For pocket welting commercially _____ _____ pocket welting machine is used.
2. Welting is functional and _____ feature of any garment.
3. _____ and _____ work process are types of fusing machines.
4. Steam press is also called as _____ press.
5. Dolly press and form press is the name of _____ finisher.

B. Questions:

1. Explain the importance of welt machine in garment manufacturing.
2. Discuss the use of welt machine in different garments.
3. Explain the process of fusing by flow chart.
4. Discuss “fusing” in detail.
5. Discuss the parameter of pressing
6. Write in detail about purpose of pressing.

Module 4	Organizational Health, Safety and Security at Workplace

Module Overview

Health, safety and security is the main concern of any organization; Garment manufacturing process can be hazardous like other industrial process. A healthy and safe environment is necessary for employee's well-being. There are many safety and health issues with the garment industry. The garment industry has to be focus on developing good working conditions to reduce these issues. Apart from these organizational policies, rules, regulation and workmen or employee security is also important. This is also discussed in brief in this unit to given an idea to the student about organizational culture. This unit covers a brief description of all these factors.

Learning Outcomes
After Completing This Module, You Will Be Able To: • Describe importance of health and safety at workplace • Explain health and safety measures at workplace • Explain steps of Storing materials and equipment • Describe organizational policy, goals, rules & regulation and workmen security
Module Structure
Session 1: Health and Safety at Workplace
Session 2: Health and Safety Measures
Session 3: Proper Storage and Waste Disposal
Session 4: Organizational Policy, Goals, Rules & Regulation and Workmen Security

Session 1: Health and Safety at Workplace

Health and safety is mandatory for an individual working in any sector. At work place it can be achieved by making and implementing laws and also creating awareness amongst the employee. Garment manufacturing process can be hazardous like any other industrial process. It is necessary that every

employers and workers should be aware of the hazards and risks accompanied with garment manufacturing and process. They should be equipped to take precautions and care to guard themselves, workers or other employee against work-related injuries and illnesses. Mostly the garment factories at present are in the commercial and residential area. Due to negligence, garment factories do not comply with safety rules. As a result workers suffer many occupational injuries and accidents. The occupational health and safety of the workers is getting more critical and complicated gradually.

IMPORTANCE OF HEALTH

Health is the primary concern of any individual. For maximum output an individual should be healthy and stress free. Work provides many economic and other benefits to the workmen or operator at workplace, but a wide range of workplace hazards present risks to the health and safety of them at work. Following are the list of different hazards which can occur at workplace:

1. Occupational hearing loss is the major work-related injury.
2. Visibility loss in embroidery workers mostly observed. Even an operator should take care while he/she works on machine.
3. Falls are regular cause of occupational accidents and injuries, in building construction, transportation, extraction, and building housekeeping and maintenance.
4. Machines have rotating and moving parts, sharp edges, heated surfaces and other hazards with the potential to crush, burn, cut, shear, stab which will strike or wound workers if used unsafely.
5. Fabric dust can be very harmful for operator. It directly affects lungs, so mask is recommended.
6. Rubber pads of machines are mandatory because it saves to operator from electric shock.
7. Prolonged sitting can be problematic for back bone that is why small exercises are recommended.

Every individual is concerned for his/her own health. In the same way an organization must also be concerned about its employee's health and ensure to follow rules and regulation set by law. To make workplace safe, it is necessary to understand what kind of problems or hazards can occur at work place. Personal protective equipment and gadgets installed at workplace can help protect against many of these hazards.

The probable hazards at garment manufacturing units can be classified as follows:

TYPES OF HAZARDS

In a garment manufacturing unit different work environment can pose different type of risks and hazard for the health of the employees. Therefore, it is necessary to recognize and resolve different type of hazards with proper precautions and measures. Possible hazards at the unit are classified as:

1. Physical hazard
2. Chemical hazard
3. Psychosocial hazard
4. Electrical hazard

Physical hazards:

An agent or circumstance that cause harm with or without touching is classified as physical hazard. Physical hazard often affects many operators in the workplace in many forms like occupational hearing loss, postural defects, falls, accidents, etc. Physical hazard affect the body directly. For example, deep and loud sound affects our hearing capacity. Regular work under noise of machine decreases the hearing ability.

Fire hazards are main and critical type of physical hazard in garments industry. Because of too much use of flammable material like cotton and other chemical in garments industry there is a great probability of getting fire any time if proper precaution is not taken.

Fire hazards occur mainly due to the following reasons:

(i) Non availability of fire and smoke alarm.

(ii) Many of the fire and smoke alarm bells are not operational in garment industries.

(iii) Fire exit or emergency staircase lacks proper maintenance.

(iv) Lack of display of proper exit route to reach the place of safety in case of emergency.

(v) Poor housekeeping at workplace which can invite a fire accident in garment or cotton industry.

(vi) Lack of training to the workmen for firefighting.

(vii) Non-availability of firefighting equipment.

(viii) Lack of disaster management policy and emergency action plan.

To avoid fire hazards:

1. Every industry must keep fire extinguishers as a safety measure for emergency.
2. Employees should be trained to handle fire extinguisher.
3. Fire safety equipment should be in working conditions always.
4. Emergency exit plan should be easy, approachable and displayed at different places.

Chemical Hazards

The various risks from chemical exposure having adverse effects on health like carcinogenic, mutagenic, repro toxic due to chemical exposure. Some health related issue e.g. nausea, respiratory problems, headaches, watering of eyes from volatile chemicals occur due to the exposure to chemicals.

Some of the risks associated with chemicals used in garment industry are:

1. Eye redness and irritation, Skin burns and rashes, respiratory problems from chemicals.
2. Dusting (resulting asthma), carcinogenic amines, allergens from dyes, reducing agents, acids and alkalis.
3. Flammability and long term health issue from solvents, resins and softeners, etc.
4. Respiratory problems from gas fumes, small fibres.

Three basic steps for controlling risks of chemicals:

1. Identification of the hazardous chemicals at workplace.
2. Identify the risks from chemicals used in process and workplace.
3. Inclusion of various control measures to eliminate or minimize the risks.
4. Eliminate the hazardous chemicals
5. Substitute with a less hazardous chemical
6. Develop engineering controls in workplace
7. Use of personal protective equipment (PPE)

Measures to be taken to reduce chemical hazards

Getting the information about the chemicals: The most important sources of information on the hazards of chemicals are the label and the safety data sheet. It should be ensured that every chemical is supplied with a label attached on container. The label gives information about the chemical or product name, the chemical hazards and the precautions should be taken into account to ensure safe handling and use of chemicals. It must be ensured that every employee or workmen should know about the safety data sheet and identify the hazards chemicals from given information.

Substitution or elimination of hazardous chemicals: It is important to prevent hazards at source by substitution or elimination of hazardous chemicals to the possible extent. If this is not possible use protective equipment's like hand gloves, mask & glasses while handling these chemicals.

Chemical safety programme: It is a basic need in every industry and a contributing factor for higher production. Due to these programs there are less chances of accidents and can improve upon productivity. The garment industry can encourage the implementation of chemical safety programmes through spreading awareness and training.

Psychosocial hazards

It includes risks to the mental health and emotional well-being of workers and employees in an organization. The causes for psychosocial hazards are feelings of job insecurity, long working hours, lack of enthusiasm towards work and poor work-life balance due to lack of appreciation. This aspect should be dealt with care as it is quite a sensitive issue to deal with the psychology of the people at workplace.

1. The addition of work related interventions for depressed or demoralize workers receiving clinical interventions minimize the number of lost work days as compared to clinical interventions done alone.

2. The addition of cognitive behavioral therapy to primary or occupational care like continuous counseling, meditation, yoga, participation in recreation centre, music therapy are effective in reducing work pressure of employee or workmen.

3. The addition of a "structured telephone outreach and care management programme" to usual care, helps at reducing sick leave days and poor work efficiency at the workplace.

For the psychosocial well-being of the employees following points should be considered:

1. Setting of counselling centre.
2. Appropriate working hours to be set.
3. Incentive for the workers for efficiency.
4. Module to find out the inefficiency of the workers and to modify that.
5. Sense of job security.

Electrical hazards-These hazards are very common in garment industry as fabrics, machines and other fire prone equipment's are used here. This is a quite dangerous condition where a worker or employee can make electrical contact with energized equipment or a conductor.

Most electrical accidents occur when the individuals engage in below mentioned activity:

- Working on or near electrical equipment which is thought to be dead but which is, in fact, live.
- Misuse of equipment's or use of electrical equipment which are known to be faulty.
- Working on equipment without adequate training or they have not taken adequate and proper precautions.

From the contact of any electrical equipment, the person may sustain an injury from shock, and there is a potential risk for the worker to receive an electrical explosion/burn, thermal burn or blast injury. Shocks from faulty equipment's can cause severe and permanent injury which can also lead to indirect injuries, due to falls from ladders, or other work platforms. Faulty electrical appliances can also lead to fires. As well as causing injuries and loss of life, fires cause damage to plant, machines, equipment and property.

Other than the hazards mentioned above some other common problems at the workplace are listed below:

(i) Inadequate hygienic and congenial working atmospheres in industry

(ii) Sexual harassment of female workers at workplace

(iii) Inadequate toilets and washroom facilities

(iv) Purified water is not available at workplace for drinking

(v) Differences in wage fixation and other facilities between male & female workers

(vi) No weekly holiday for female workers

(vii) Absence of recreation facilities for workers

(viii) Facility of baby care center for female workers not present.

Precautions to be taken to avoid hazards

Listed below are some vital suggestions regarding health and safety of workers:

1. Respiratory & hand protection.
2. Eye protection.
3. Heat stress protection.
5. Supply of pure drinking water to avoid illness.
6. Setup adequate amount of wash rooms for the worker to maintain cleanliness around work place.
7. Ensure recreation facility for workers to remove monotonousness from work.
8. Setup baby care center for the female worker for safety of their childs.
9. Setup medical center for first aid treatment.
10. Fire protection
11. Finger protection
12. Proper lighting
13. Ergonomic design of the work station.
14. Awareness towards physical and psychosocial health.
15. First aid medicine
16. Training program for health safety issue.
17. Set up safety plan and adequate training so that at the time of emergency all employees should be aware of next action/evacuation/firefighting/first aid/information to right authority.
18. Each organization prepares its own safety plans/methods and management has to assure that all employees are following rules.

STEPS OF REPORTING TO CONCERNED PERSON IN AN ORGANIZATION AT THE TIME OF EMERGENCY

To make safe and healthy environment every organization must

1. Make emergency plans which teaches how/who must be contacted in case of any emergency.

2. As per emergency plan of any organization all the contact numbers of relevant persons/authorities should be on notice board.

3. The contact number of nearest hospitals, nearest police station, fire station, labor office also should be on notice board.

EMERGENCY ACTION PLAN

After knowing in detail about the hazards it is necessary to be aware of emergency plan. The objectives of the action plan are:

a) To control the emergency, localize it and if possible eliminate it.

b) To avoid confusion, panic and to handle the emergency with clear cut actions.

c) To minimize loss of life and property to the plant as well as to the neighborhood.

d) To make head count and carry out rescue operations.

e) To treat the injured persons.

f) To preserve records and to take steps to prevent recurrence.

g) To restore normalcy.

Components of emergency action

1. Identifying emergency situation
2. Nature of emergency
3. Coding of siren
4. Emergency control center
5. Assembly points
6. Training and education
7. Mock rehearsals
8. Updating the plan
9. Safety equipment's

1. IDENTIFYING EMERGENCY SITUATION

It is a situation, which may lead to or cause large-scale damage or destruction of life, property or environment within or outside the unit. Such an unexpected situation may be too difficult to handle for the normal work force within the plant.

2. NATURE OF EMERGENCY

Identify the nature of the situation. It can be:

a. Fire/Explosion.

b. Major accident such as structural or construction collapse, overturning of road tanker with flammable substances.

c. Natural calamity like storm, flood, earthquake, etc.

d. Sabotage act of terrorism, civil commotion, air raid etc.

3. CODIFICATION OF SIREN

Table 4.1: Codification of Siren

Sr.	SIRENS	INDICATES	AUTHORITY
1.	30 second continuous	On site emergency (alert)	Incident controller
2.	1 minute continuous	Emergency controlled (all clear)	Site controller

1. Emergency siren to be sounded only if required.
2. All employees in areas other than affected to continue work unless disaster siren is blown.
3. No emergency organization member should leave the emergency spot unless 'all clear' siren blown.

4. EMERGENCY CONTROL CENTRE:

For the purpose of handling emergency, the following Emergency Control Centers should be identified.

- During normal working hours - The HR& security office
- During other times - The security office.

All communications to and from to be originated at this control centre. The emergency control center will have the following:-

a) A copy of on-site Emergency Plan.
b) List of important telephone numbers such as police, fire-brigade, hospitals, and other outside emergency services, etc.
c) List of key personnel with addresses and telephone numbers.
d) List of fire and rescue squad members.
e) List of fire extinguisher.
f) Firefighting system.
g) List of personal protective equipment.
h) First aid box.

5. ASSEMBLY POINTS

In case of an emergency the employees should assemble near the defined assembly points, as indicated below: -

- Fire Fighters - Area near Security Gate.
- First Aiders - Area near Security Gate.
- Others - Area near Security Gate.

Wind direction to be determined by the wind socks installed on top of the engineering building. The employees should run perpendicular to the wind direction and not against / along the wind direction.

6. TRAINING AND EDUCATION:

Experience with on-site emergency planning has proved the need of training and rehearsal. Major emergency procedure should be laid down clearly and convincingly to everyone on site particularly key personnel and essential workers. In house or outdoor training is essential. The duties and responsibilities of each person and the emergency procedure to be followed by them should be very clear. Emergency instruction booklet containing all detailed emergency duties**,** reporting relationship should be prepared. Thus everyone should know about his role in the Emergency Plan.

7. MOCK REHEARSAL:

It should be planned and executed time to time. To conduct mock rehearsal:

1. Inform all the employees about mock drill.
2. Fix the date for mock drill.
3. Observers will not participate in the exercise. They will monitor the mock drill.
4. Emergency siren will be raised.
5. After hearing the siren, emergency procedure will be followed.
6. Observer will note the activities with respect to the time.

8. UPDATING THE PLAN:

Whenever required the on-site emergency management plan will be updated. After each drill the plan will be thoroughly revised to take account of shortcoming and plan will be updated accordingly. In this plan organization explains/teaches employees various valuable learning related to emergency.

9. SAFETY EQUIPMENT

Table 4.2 List of Fire Extinguisher & their types

Sr. No	Types of Extinguisher	Total Nos.	Place
1	DCP		
2	CO2		
3	Foam		
4	Sand Buckets		

4.3 List of Personal Protection Equipment

Item	Nos.
Safety helmet	01
Safety goggles	01
Safety shoes	05
PVC apron	02
Asbestos gloves	05
Rubber gloves	05
Eye wash fountain	05
Gum boots	02
Safety belt	04

FIRST AID MEDICAL FACILITIES:

The company has provided "first–aid" boxes at security office. Following are the contents of first-aid box.

1. Tincture iodine
2. Eye wash solution
3. Ointment for burns
4. Ointment for cuts and wounds
5. Sterilized cotton wool
6. Band-aid
7. Antiseptic solution
8. Bandage
9. Tablets
10. Ointment for body ache/pain
11. Pair of scissors

Apart from first-aid some time due to severe injure employee has to be hospitalized. For this every company has got its own transport facilities to take the injured to the hospital.

Activities

ACTIVITY 1: Prepare a chart on types of hazards.

Material Required:

1. Chart sheet of A3 size
2. Pencil, marker, eraser, pens
3. Ruler

Step by Step Procedure:

1. Write down the types of hazards that can occur at a workplace with examples on the sheet.
2. Also write down the steps to be taken while facing these hazards and reporting procedures.
3. Place the chart in classroom or practical lab.

ACTIVITY 2: Prepare a report on emergency action plans followed in garment manufacturing units.

Material Required:

1. Practical file
2. Pencil, marker, eraser, pens
3. Ruler

Step by Step Procedure:

1. Visit any garment manufacturing unit and note down the details of their emergency action plans.
2. Prepare a report and also mention their reporting procedure in case of hazards/emergencies.
3. Submit your report.

Check Your Progress

A. Multiple Choice Questions:

1. _____ _____ mostly affect many people in the workplace.
   a) Physical hazards
   b) Electrical hazards
   c) Chemical hazards
   d) Psychosocial hazards
2. 30 seconds continuous siren indicates _____ _____ _____.
   a) on site emergency
   b) emergency controlled
   c) no emergency
   d) emergency action plan
3. _____ _____ hazards are very common in textile industry as fabrics, machines and other fire prone equipment are used here.
   a) Physical hazards
   b) Electrical hazards
   c) Chemical hazards
   d) Psychosocial hazards
4. OEP stands for_____ _____.
   a) Operating effective plan
   b) Organization electricity power
   c) Order effective preparation
   d) Organization evacuation plan

B. Questions:

1. Explain physical, chemical, electrical and psychosocial hazards at work place.
2. Write down the precautions against hazards.
3. Explain effects of exposure to noise.
4. Explain the emergency action plan in case of hazards/emergencies.

Session 2: Health and Safety Measures

SAFETY

It is important for employers and workers to have proper knowledge of the hazards associated with garment manufacturing work area and take precautions to safeguard against work-related hazards, illnesses and injuries. There are various safety and health issues associated with the garment and textile industry due to working environment and machineries used.

There are various types of machinery used in the garment industry. That involved the functions like:

-knit and weave;

-sew or cut patterns and cloth;

-press or steam;

-transport garment pieces on the factory floor

But before beginning of any work on machine, the operator should be trained in proper operation of machines and all safety precautions to follow. Workers should be trained to know that any machinery with exposed moving parts should be properly guarded.

Fig. 4.1: Workers performers task in garment manufacturing industry

In garment industry hazards can be avoided by taking proper precautions with following:

- Cutting tools
- Knitting or sewing needles
- Garment inspection
- Machine noise

- Working comfort
- Fatigue at workplace

Cutting tools:

- Using sharp tools that are in good condition;
- Carrying and storing sharp tools properly;
- cutting should be carried away from the eyes and body.

Knitting or sewing needles:

- Need to stay alert when working with Needles & sharp objects;
- Make sure needles are properly guarded.

Garment inspection:

- Using proper shields on high-speed sewing machinery;
- Wear Safety glasses where required;
- Adequate lighting at individual workstations to prevent eye strain.

Machine noise:

- Use of ear plugs in noisy area

Working comfort:

- Proper ventilation;
- Maintaining ambient temperature;
- Allow enough space for different task;
- Having appropriate working height;
- Provide proper seating.

Fatigue at work place:

- Rotate tasks to avoid monotony while working;
- Take frequent breaks from work for stretching and relaxing muscles.

With proper instruction and training, machine protections, personal protective equipment, and ergonomically designed work systems, garment workers can manufacture products in safe and healthy workplaces and environment.

Importance of ergonomics at work place in a garment manufacturing unit

To prevent ergonomic injuries operators or workers should be encouraged to rotate tasks and take breaks from work to stretch and relax muscles. Workstations should allow sufficient space for the task, have appropriate working height, and provide proper seating. Manufacturing tools and machinery should be according to the ergonomic design principles and should not require an extra amount of force energy to operate.

Fig. 4.2: Wrong seating posture

Poor ergonomic condition affecting health

- Unsuitable furniture,
- improper ventilation and lighting,
- Lack of efficient safety measures in case of emergencies.
- Difference in the heights of the stools and the tables
- Poor illumination or visibility

Occupational disease due to poor ergonomic conditions

- forearm tendinitis,
- bi-capital tendinitis,
- carpal tunnel syndrome,
- epicondylitis,
- neck pain,
- lower back pain,
- osteoarthritis of the knees
- shoulder pain, and

The units where ergonomic conditions not maintained are at risk for developing various occupational diseases which are listed above. Also some other issues like difference in the heights of the stools and the tables are used for various operations such as cutting and ironing. This leads to the workers having to sit in an uncomfortable position for entire work days. Generally, the stools are not padded in most of the units, leading to increased discomfort for the workers. Moreover, the stools do not have a backrest, as a result of which the workers do not get sufficient support to the back.

Some basic ergonomic principles that should be followed in workplaces:

(a) Proper tools

- Tools should be suitable for the specific tasks being performed. The tools should allow you to keep your hands and wrists straight– the position they would be in if they were hanging relaxed at your side. The workers should bend the tool – not the wrist.
- The tool should fit comfortably into your hand. If the grip size is too large or too small, it will be uncomfortable and will increase the risk of injury. Tools should not have sharp edges, create contact stresses in your hand, or vibrate.
- Even some tools like needle guard, ear plugs, finger guard and transparent eye glasses can be used as protective tools while working on specialized machines.

(b) Keep repetitive motions to a minimum

- Workstations can often be re-designed to reduce the number of repetitive motions which should be performed. Using a power-driven screwdriver or tools with a ratchet device can minimize the number of twisting motions with the arm.
- To prevent ergonomic injuries workers should be encouraged to rotate their tasks or can have frequent and short breaks to stretch and relax muscles.
- Work stations should allow enough space for the different tasks having appropriate working height, and provide proper seating.
- Manufacturing tools and machinery should be according to the ergonomic design principles and should not require excessive amount of force/energy to operate.
- Some tasks can be automated or redesigned to remove repetitive movements and musculoskeletal injuries.

(c) Avoid awkward or wrong postures

- You should not work with your hands above shoulder height on a regular basis.
- Arms should be kept low and close to your body.
- Bending and twisting of the wrists, back and neck should also be avoided.

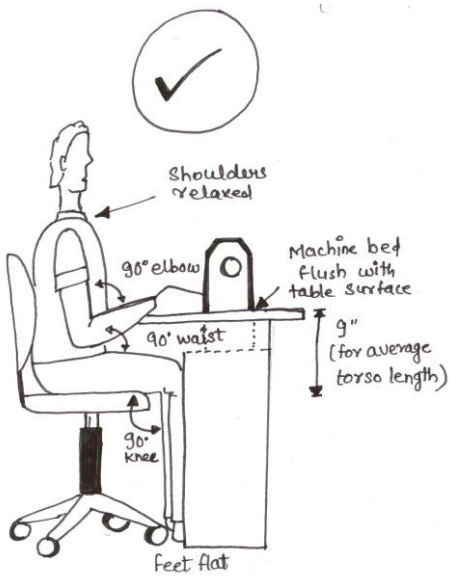


Fig. 4.3: Proper posture while working

(d) Use safe lifting procedures

- Avoid lifting objects that are too heavy.
- Use more than one person or a mechanical device to reduce the load.
- While lifting at the workstation you are not required to lift objects above your head or twist your back.
- Keep the load close to your body and make sure that you have a good grip.
- Heavy and regularly lifted objects should be stored between knee and shoulder height– not on the floor or above your head.

(e) Get proper rest

- The workers need to rest their body and mind in order to avoid injuries.
- Give your muscles a rest during your coffee/tea breaks, lunches time and weekends by doing some different activities from what you do in your regular job.
- If you keep standing whole day, while performing your job you should sit down to rest your legs and feet during your breaks.

- If you sit down, when working you should stand up and walk around during your breaks to give your back rest and to increase circulation in your legs. By doing this the musculoskeletal injuries can be prevented.

(f) Good Lighting

- Proper lighting conditions are critical for good productivity.
- Conversely, poor lighting arrangement can cause mainly eye strain, fatigue and headache.

Practices for good lighting

- Workstations that need more light should be moved closer to windows.
- Use a combination of natural and artificial light arrangement and adjust lighting
- Interior colour affects how much light is required.
- Ensure that the ceilings should be as close to white as possible.
- Use pale colors on walls.
- Use local lighting when necessary for some types of fabric, thread or seams at the needle point.
- Re-orient the workstations to maximize the use of available lighting arrangement.

Benefits

- Improved quality and higher productivity.
- Decreased fatigue and work-related illnesses like eye strain and headaches.
- Improved health condition of the workers leads to a reduction in absenteeism.

Safety and health measures play an important role in any industry. It is necessary that the workers should be aware of the various occupational hazards in the industry. At the same time, it is necessary that the management take the steps to protect workers from hazardous situations.

Recommendations to improve the safety and health conditions in garment manufacturing units:

1. The seats of the workers and the tables should be well aligned in height so that there is no musculoskeletal strain.

2. There should be proper lighting at workplace to avoid eye strain.
3. Machinery should be well maintained to reduce the level of noise. If necessary, certain parts of machines can be replaced.
4. In case the noise level cannot be controlled, workers should be provided with earplugs so that exposure to noise can be reduced.
5. Workers can be rotated within jobs so that they are not faced with continuous noise exposure for a long period of time.
6. There should be proper ventilation at the place of work.
7. In order to reduce the exposure to dust, workers should be provided with masks.
8. Medical aid and first aid facilities as well as safety equipment like fire extinguishers and fire alarms should be available at the workplace.
9. Proper dust control equipment should be set up and maintained to minimize the worker's exposure to cotton dust.
10. Medical test should be conducted by the employers for the workmen periodically. If significant occupational health problems are observed, appropriate measures should be taken by the management.

The garment industry should regularly identify the problems and, more importantly, implement solutions to minimize the risk of injuries in situations where they know problems exist.

Important safety instructions while working on specialized machines:

1. Read all the instructions in the manual of the specialized machine before starting your work.
2. Use the machine only when it conforms to the standards & rules of your manufacturing unit.
3. All safety devices must be in position while operating the machine. Operating without the specified safety devices is not preferable.
4. The machines should be operated by the trained operators.
5. Operator should wear safety glasses.
6. Turn off the power switch of the machine for the following:
    - For threading needle, replacing bobbin, presser foot, looper, feed dog, needle guard, etc.
    - For repair work
    - When the work place is unattended and while leaving the work area
    - While using clutch motors without applying brakes. One must wait till the motor stops

7. Immediately wash any oil or grease used on machines or on its devices to avoid its contact with your eyes or skin. In case of any contact to your skin, consult a doctor.
8. Tempering with live parts and devices, regardless of whether the machine is powered, is prohibited.
9. Repair and adjustment work must be done by trained technicians and especially skilled personnel.
10. General maintenance and inspection should also be done by trained personnel.
11. Before making the maintenance and repair work of machines equipped with pneumatic parts such as air compressors, detach the compressor so that the air supply is cut off.
12. Periodically clean the machine throughout the period of use.
13. Grounding the machine is necessary for the normal operation of the machine.
14. Machine should be operated in a sound or noise free environment.
15. Power plugs should be attached to a grounded by electricians.
16. The machine is only allowed to be used for the intended purpose, other uses are not allowed.

Safety Rules for safe working operations on specialized sewing machine

Safety is important to everyone and it is everyone's responsibility to maintain a safe working place. To maintain a safe environment, learn safety rules and practice them during work. Following points to be kept in mind:

1. When in doubt, ask the instructor.
2. Report any injuries or accidents immediately to the instructor.
3. Report the breakage of a tool or machine to the instructor. If the equipment does not operate properly, notify the instructor immediately.
4. Keep aisles clean and clear all the times.
5. Operate only those machines for which you have been trained to operate.
6. Always inspect the machine before starting to work make sure that it is clean and threaded correctly, with no loose threads on the pulley belt and all guards in place.
7. Make only adjustments you have been trained to perform. Otherwise, ask the instructor.

8. When working on sewing machine wear low shoes and close-fitting garments. Avoid loose fitting sleeves, sweaters, jewelry, ties, and ribbons, while operating the machine. If your hair is long, tie it back.
9. Always practice proper posture to reduce fatigue, help prevent accidents and increase efficiency. If possible, adjust the chair height that your feet rest flat on the floor.
10. Do not take chair forward or toward while operate the machine.
11. Use both hands to raise and lower the machine head.
12. Always keep your head above the table.
13. Keep your feet off the treadle when you are setting or threading the needle.
14. Turn the motor off if not stitching.
15. Turn the motor off before cleaning, oiling or adjusting the machine.
16. Turn the motor off before removing or replacing the pulley belt and run the machine out. Wait until all motion has stopped.
17. Turn the motor off in case of an emergency or when in doubt.
18. Turn the motor off before unplugging the machine.
19. When unplugging the machine, hold onto the plug, not the cord.
20. Do not use your hand to stop and start the hand wheel.
21. Use your hand only to set the hand wheel.
22. Before operating the machine, close the slide bed cover.
23. Before operating the machine, be sure the needle is properly set and the bobbin is properly placed.
24. While operating machine do not be careless & do not talk with your colleagues.
25. Keep your attention on your work and hands.
26. Keep your hands at a safe distance from the needle.
27. Keep your hands, scissors, and other sharp objects away from the belt.
28. Keep the machine and work station clean with tools in the side drawer.
29. Use the proper needle for the job.
30. Do not stitch over pins or put them in your mouth.
31. When the machine is not in use, lower the foot and needle.

32. Three-way plugs are a safety feature on the machines. Do not cut off the ground prong.
33. Unplug the machine at the end of the day.
34. Know the location of the main power switch, outlets, and fuses in case of an emergency.
35. Do not remove any safety devices from the machines.
36. Turn off the iron after work.
37. Always place the iron on the iron pad to avoid scorching the ironing board cover.
38. Always place the industrial iron flat on the iron pad to avoid knocking it over.
39. When trimming or cutting, put all trimmings in the wastebasket.
40. Scissors should be handed to another person with the handles toward the person.
41. Never toss or throw scissors or equipment.
42. Do not eat, drink, or smoke in the work area.

Activities

Activity 1: Students will watch a short video on health and safety measures that should be taken by garment industry. Prepare a report of it.

Material Required:

1. CD/DVD of short video
2. Internet access for online video
3. CD/DVD player or laptop
4. Projector
5. Screen
6. Seating arrangement for students
7. Pen, pencil
8. Practical file

Step by step procedure:

1. The teacher should arrange to make the students watch a short video on the health and safety measures in industry.

2. The teacher should organize a group discussion regarding the same.
3. Following the instructions of the teacher, prepare a report on the health and safety measures in industry.
4. Submit the report.

Check Your Progress

A. Fill in the blanks:

1. Many tasks in garment manufacturing require _____ motions.
2. To prevent _____injuries workers should be encouraged to rotate tasks or take frequent short breaks to stretch and relax muscles.
3. Workstations that need more light should be moved closer to_____.
4. To reduce the exposure to dust, workers should be provided with_____.

Questions:

1. Explain any safety measures to be taken in a manufacturing unit.
2. Explain how good lighting help at a manufacturing unit.
3. State points to improve the health and safety conditions at work place.

Session 3: Proper Storage and Waste Disposal

Solid wastes from textile and apparel factories consists of textile materials and supplies that are not as per the required quality standards or remain after being used in production. Inferior quality of raw materials should not be accepted if textile companies would like to attain better, efficient and speedy production operations and to reduce the amount of waste they generate. Materials that remain after being used should be sorted carefully during production and related industrial organization should be contacted to seek ways of reusing these materials. Various accessories are used while the fabric is transformed into a garment. If a garment is to be described as environmentally friendly, every single piece of the garment should be environmentally sound and should match environmental norms. Especially, buttons, metals in zippers, nickel in buckles, chromium in leather accessories, neoprene-based adhesives, rubber in sponges and hooks in underwear fall in this category.

SOCIAL RESPONSIBILITY OF COMPANIES

Current consumer demands such as better quality, minimum price and made-to-order clothes, the concept of clean cloth has also emerged as an essential concept in textile production. This is related to textile products that do not pollute the environment, pose any problems to human health and violate the social rights of employees who are supposed to work under internationally accepted work and social standards. Public feedback against clothes made by companies that fail to fulfill with these requirements may affect the market share of these companies negatively. For commercial customers and manufacturers, this could discredit their trademarks and cause sales to drop.

First of all, national legal directives pertaining to protection of the environment must be implemented.

Contamination of underground water reservoirs and drinking water by chemicals must be taken care. The personnel responsible for storing and disposing these chemicals must possess required qualifications. It would be better if the chemical waste is disposed of by a specialized firm.

Chemical substances should not be mixed with other waste materials. Storing and burning wastes in open areas must be prohibited. Waste materials must be kept in safe areas so that it would not pose to any threat to employees. For instance, keeping such waste in the corridors or on the landings could block emergency exits, causing a safety hazard.

Waste water must be treated at a waste water treatment plant, liquid and solid oil must be passed through separate filters. They must be emptied and cleaned regularly and the contents must be disposed of properly.

WASTE MANAGEMENT IN TEXTILE AND APPAREL INDUSTRY

Wastes are generated during different stages in the lifecycle of the product which are following:

- Manufacturing
- Usage
- Discarding the textile product as waste.

Due to disposal and discharge of waste materials freely and carelessly, hazardous substances in the waste contaminate the soil. Hence, this pollution can be carried down through underground layers with the help gravitation. Thus, waste collection areas turn into chemical reactors which cannot be controlled easily and these uncontrolled piles of waste materials become potential explosives.

The solution for discarded materials which cannot be recycled in or outside the plant is to convert these materials into heat energy and minimize the risks involved by means of anti-leakage measures.

The 5R principle of waste management can also be applied to textile and apparel wastes. These are given briefly as follows:

- Reduce
- Reuse
- Recover
- Replace
- Recycle

Fabric wastes generated in textile and apparel factories can be divided into 4 groups:

- Fabric type (woven fabric, knit fabric)
- Fabric size
- Fabric content
- Fabric colour

For increasing sales of a garment product and to give it attractive look for customers, a variety of aesthetic materials and accessories are used in packaging. Though it is known for a fact that packaging materials and accessories are quite important as part of successful sale strategies, it should be kept in mind that some of these materials have nothing to do with the functional use of the product. At the end, these will be nothing but wastes and will have to pass through certain recycling processes. Therefore, it would be better to assess this matter with respect to environmental protection and protection costs, one should omit packaging materials and accessories not related with the functional use of product and develop new techniques to increase sales.

Collecting waste regularly at the end of the useful working life-span of a product is one of the very important activity of waste management.

THE WASTE RECYCLING EXCHANGE

Waste materials generated during the production process of a plant can be used as raw materials in another. For this reason, the waste recycling exchange was setup within the framework of environmental protection practices so as to reuse the wastes generated during the production processes in various other sectors of the industry.

The waste recycling exchange provides the following advantages to companies:

- The exchange reduces extra spending of the company for the disposal of wastes.
- Buying of these wastes by another company turn these into an investment.
- Financial burden due to storing these wastes is automatically eliminated.
- Joining the exchange contributes to environmental protection initiatives.

A large number of prospective purchasers increase the financial value of these wastes. For that, certain pieces of information should be presented to the waste recycling exchange about the waste materials generated during the production process.

- Type and composition of the waste material
- Possible pollution data
- Frequency of waste generation
- Quantity
- Form of shipment
- Type of packaging

Some of the wastes from the textile and apparel industry that can be reused by the exchange are as follows:

- Cotton seeds from cotton gin mills (used in oil and feed factories)
- Greasy cotton and blend waste discarded by cotton yarn and cotton production facilities
- Waste materials such as comber waste, off-combing, plucked yarn (used in rough yarn factories)
- Carpet hems from carpet factories (raw material for bed fibre factories)
- Fabric hems and sewing yarn discarded by apparel companies
- Sacks, empty barrels, drums and cardboard boxes.

CONCLUSION

Rising environmental problems have requested companies manufacturing goods to meet basic necessities of people to turn their looks to environment-based management strategies. This new approach also forms the basis of ecological production. The main objective of ecological production is to adopt and implement certain strategies that can make maximum use of nature without upsetting the ecological balance.

Due to the changing demands and technologies, textile and apparel product, which are among the basic necessities of people, can negatively affect the environment as well as humans during the production, usage and disposal stages. The share of environmentally friendly eco-textiles within international textile and apparel trade has been increasing so as to minimize hazardous effects. Significance attached to ecological safety by consumers (end users) and their understandings of liability have provided great assistance to this issue. Further improvement of the present level of ecological awareness will help parties involved in various processes in textile trade and production to set more competent and to-the-point environmental quality standards.

Activities

Activity 1: Prepare a report of waste management.

Material Required:

1. Practical file
2. Pencil, marker, eraser, pens
3. Ruler
4. Camera (if available)

Step by Step Procedure:

1. Visit any garment manufacturing unit and note down the details of their waste management methods/procedures
2. Take photographs (if possible) of the methods.
3. Prepare a report along with photographs and also mention the types of waste in their organization and the ways to recycle the waste they use.
4. Submit your report.

Check Your Progress

A. Fill in the Blanks:

1. The 5R principle used in waste management applied to textile and apparel wastes are reduce, _____, recover, replace and _____.
2. Waste materials generated during the production process of a garment can be used as _____ _____ in another process.

Questions:

1. Explain the 5R principle of waste management.
2. Explain the four types of fabric wastes.
3. Explain the advantages of waste recycling exchange.

Session 4: Organizational Policy, Goals, Rules & Regulation and Workmen Security

For smooth functioning of any organization it is necessary to have defined organizational policy. Organizational policy consists of guideline and practices to be followed which in turn will protect employee, company & customer. In other words, organizational policy defines what is to be permitted and not permitted within organization. Types of related policies:

- Health and safety policy deals with health and safety of employee.
- Quality policy deals with the quality of the products to be produce by organization.
- Security policy includes security of the employee like industrial security and social security.
- Energy conservation policy includes the energy saving by optimum use of available resources like electricity, steam etc.
- Welfare policy deals with welfare of the employee and the society.
- Grievances policy deals with employee's grievances in case of emergency or accidents.
- Accidental policy is similar to the grievences policy. This includes grievances paying to the employee in case of accidents.
- Mediclaim policy deals with medical expenses reimbursement to the employee in case of severe illness or injury.
- Provident fund & pension policy includes the provident fund payment or deduction to employee or pension payment or deduction to employee.
- Sexual harassment policy deals with women social security at work place.
- Customer policy provides guidelines on dealing with customers and customers expectation from the organization.
- E-policies deals with the communication guideline to followed by the employee through internet and E-mail.

Purpose of Organizational Policy

- It provides clear definition to employee of boundaries within which he/she has to work
- It defines policy acceptable and unacceptable behavior of employee
- It also provides guidelines for dealing with inappropriate behavior of employee.

- The policy also set expectations of customer.

Benefits of Organizational policies

- It encourages consistent organizational performance and behavior.
- It provides a support for consistent service to customers.
- It also safeguards the organization against legal issues or liabilities.
- It helps to protect organizations and customer proprietary information and other assets.
- It helps both employer and employee to react at different situations in similar way.
- This also reduces the chances of unfair practices in organization.

Importance of Organizational Policies

- It provides clarity to the reader when dealing with accountability issues that is of critical importance to the organization.
- It helps to support and explain the standards expected from employees and help employers manage staff more effectively.

Organizational Goal

- Organizational goals are planned objectives that a company's management set to outline expected outcomes and guide employees' efforts.
- There are many advantages to set organizational goals.
- They guide employee hard work.
- It validates a company's activities and survival.
- It defines performance standards.
- It provides constraints to pursue unnecessary goals and function as behavioral incentives.

Importance of Organizational Goals

- It helps to define a company's intention or purpose,
- It assists in company's growth and achieving financial objectives.
- Setting definite organizational goals can also help a business to measure their organization's progress.
- It determines the tasks to be enhanced to meet specified business goals.

- Goals have to be specific, achievable, measurable and timely.
- Organizations have a clearer path to achieve success by setting clear and realistic goals.
- Goal setting and achieving them will help an organization to achieve increased productivity, efficiency, and profitability.
- Organizations should clearly address organizational goals to engage employees in their work and attain the organization's desired ends.
- The clear knowledge of organizational goals helps employees decide their course of action to help the business to attain set goals.
- Employees should also be ready with the appropriate tools and resources required as they do their work to meet the overall organizational goals.
- Setting goals can also help organization to evaluate employee performance.
- By developing sound goals helps organizations with planning.
- With the time goals may become unrealistic and need to be modified accordingly.

Rules and Regulations

- Rules can be defined as the guidelines or instructions of doing something correctly.
- These are the principles that manage the conduct or behavior of employee or a person in an organization or country.
- In other words, regulations refer to the directions or acts enforced by law, in a particular country.

Organizational Rules & Regulations

- This also specifies desired behavior of employee in company or organization.
- This will give an employee or individual guidelines to follow when entering into a specific business or contract.
- These are made to enforce laws at workplace.

Importance of Rules and Regulations

- Rules and regulations can help to keep employee or workmen safe and secure from business and industrial practices.
- Rules and regulation can ensure fair competition of companies.
- Regulations ensure that businesses do not fail due to raise prices.

Objectives of Rules and Regulations

- To safeguard the companies interest.
- It protects the company from lawsuits.
- It helps employee to understand what is expected from him/her.
- If employee violate the rules what will happen to them.

In organization all above discuss points are of equal importance for the long term growth of the company. The company's profitability, productivity and efficiency are should be consistent in long run it is main function of all organizational policies, rules and regulation and goals.

Workmen Security

The workmen security system in country is consist of number of schemes and programs spread through variety of laws and regulations. The industry in India has very basic social security systems for workmen to safeguard them. In our country there are two major security plans.

1. Employees provident fund scheme: This scheme is run by Employee provident fund organization (EPFO). This scheme applies to organizations with at least 20 employees or workforce. The employer has to pay contribution the employees PF scheme if they are earning up to Rs.15000 per month (subject to change with new rules)

2. Employee state insurance scheme: This scheme is run by Employee state insurance corporation (ESIC). In some ESIC schemes there is employer contribution required from all companies and in some cases this is applicable where there are minimum 10-20 workmen.

Apart from above workmen security schemes includes:

- Pension
- Health insurance
- Medical benefit
- Disability benefit
- Maternity benefit
- Gratuity

Above all schemes are made compulsory by the Government in organized sector. But in Unorganized sector these schemes and benefit are not given to employee or workmen.

Activities

Activity 1: Prepare a survey report of organizational plan.

Material Required:

1. Practical file
2. Pencil, marker
3. Eraser, pens
4. Ruler
5. Camera (if available)

Step by Step Procedure:

1. Visit a garment industry discuss with the concerned official regarding their policies rules, regulations and goals.
2. Collect the information about workmen security schemes and policies in visit.
3. Prepare a report.
4. Submit your report with photographs (if possible).

Check Your Progress

A. Fill in the Blanks:

1. Organizational policy is consisting of _____ and _____ to protect employee, company & customer.
2. Rules can be defined as the _____ or _____ of doing something correctly.
3. The workmen security system in country is consist of number of schemes and programmes spread through variety of_____ and _____.

B. Questions:

1. What is organizational policy?
2. What are the organizational goals?
3. What is the importance of rules and regulation?
4. Explain workmen security & policies laid by government.

Module 5	Quality Control in Stitching Process

Module Overview

Quality adds to the total satisfaction of a customer. In technical term, garment without any defect with proper fit, fabric, design at acceptable price is quality garment. In any production system, quality control plays important role. All process of garmenting is having quality check process like pre-production defects which includes fabric defects, defects arising while production that is the stitching defects and the post production defects finishing, labeling or final sizing defects and finishing. Therefore, quality should be checked on all levels to bring it to the acceptable level. To achieve this, it is necessary to have information about the factors contributing to quality of any product. This unit deals with the types of defects, their remedies and the factors affecting the quality of garment.

Learning Outcomes
After Completing This Module, You Will Be Able To: • Describe quality control process and its importance in garments • Narrate types of faults & corrections required in stitching process
Module Structure
Session 1: Quality Control Process and Its Importance in Garments
Session 2: Faults/Defects in Stitching Process: Types and Remedies

Session 1: Quality Control Process and Its Importance in Garments

QUALITY

In simple language need of customer is to be satisfied 100%. Thus Quality is total satisfaction of a customer. In technical term garment without any defect with proper fit, fabric, design at acceptable price is a quality garment. In any production system, quality control plays important role. Market is very competitive and without quality product a factory cannot run successfully. While any factory receives order or any tailor receives order

they have to follow the accurate fabric detail, trim, process of design, process of production etc.

QUALITY IN GARMENT PRODUCTION:

Every organization which is concerned about quality should have a quality department. All process of garment construction is having quality check process. We can divide QC in three parts:

1. Pre-production quality check
2. In process quality check
3. Post production/final check

1) **PRE PRODUCTION QUALITY CHECK**: These quality checks It is similar like when you built a house, its base should be strongest. In this process following are checked for quality:

A) Fabric

B) Thread

C) Trims/accessories

A) FABRIC: The basic requirement of a garment is fabric so it is very much necessary to check quality of fabric. For fabric checking 4-point system is recommended for garment industry and is defined as accepted quality level (AQL) or defects per hundred unit (DHU).

AQL is designed as the maximum average defective items in a lot. It is expressed in a percentage number of average defective items can simply be identified by following a form:

- The AQL system defines a minimum acceptable number of defects that can be acceptable
- Usually this is set at AQL 4.0
- Increasingly customers are specifying AQL 2.5 or 1.5
- AQL level does not reflect the actual standard of product quality. There is AQL chart:

The table below explains 4-point system for fabric quality checking.

Table 5.1: 4-point system for fabric quality checking

Size of Defect	Penalty Points
Length of defects in fabric (either length or width)	
Defects up to 3 inches	1
Defects > 3 inches ≤ 6 inches	2
Defects > 6 inches ≤ 9 inches	3
Defects > 9 inches	4
Holes and openings (largest dimension)	
1 inch or less	2
Over 1 inch	4

How to calculate total points:

In 4-point system fabric quality is evaluated as unit points/100 sq. yards and is calculated by formula:

Points / 100 sq. yd. = (total points in roll x 36 x 100)/ (fabric length in yard's x fabric width in inches). Fabric roll containing 40 points per 100squ are yard are acceptable.

Example: A fabric rolls 100 yards long and 42inches' width contains following defects:

Table 5.2: Fabric defects

4 defects up to 3-inch length	4 x 1	4 points
3 defects from 3 to 6-inch length	3 X 2	6 points
2 defects from 6 to 9-inch length	2 X 3	6 points
1 defect over 9-inch	1 X 4	4 points
	1 X 4	4 points

length 1 hole over 1 inch		
Total defect points		24 Points
Therefore, Points/ 100 sq. yards	= (24 X 36x100)/(100 X 42) = 20.571 points	

The above fabric is within the acceptable level of 40 points so it is accepted.

DHU – Defect per Hundred Units:

- DHU denoted the total quality % of a production line or a whole plant / unit. It helps to improve the quality level after reducing the defects.

Table 5.3: Defect per Hundred Units

Line/Section No	T-1	Checker Name	Radha	Total Units Checked	532
Style No	CRD004	Date	15-12-2017	Total Defects Found	36
				DHU	

Table 5.4: Checked fabric

HOURS	TOTAL PIECES CHECKED	NO OF DEFECTIVE PCS	TOTAL DEFECTS FOUND	REMARK	
HOUR-1					
HOUR-2					
HOUR-3					
HOUR-4					
HOUR-5					
HOUR-6					

HOUR-7					
HOUR-8					
OT HOURS					
TOTAL					

Check sheet or Inspection Format

Every company should keep record for fabric checking. These all defects are mentioned in this format or sheet. It includes general details, details of fabric lot, fabric defects according their sizes, summary of fabric defects, quantity inspected and total penalty points and result of the fabric lot after inspection.

Types of defects found in fabric

One should know common defects found in fabrics and he must recognize defects on the fabric at the time of fabric inspection. General defects found in fabric are:

1. Knots/broken filament

Fig. 5.1: Knots/broken filament

2. Oil Stains-Color Stains

Fig. 5.2: Oil Stains-Color Stains

3. Color Bar

Fig. 5.3: Color Bar

4. **Cuts/ Holes**

Fig. 5.4: Cuts/holes

5. Skipped stitch or broken stitch:

Skipped or jumped stitch is seam where upper thread is loose that's why formation does not come proper. Some where you will get straight thread as given in below diagram.

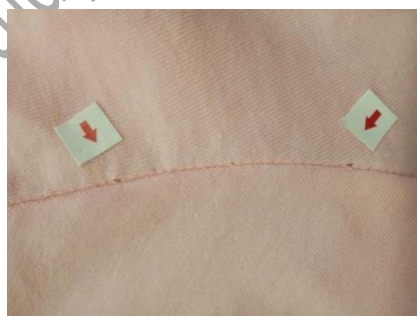


Fig. 5.5: Skipped stitch or broken stitch

Fig. 5.6: Broken stitch through lockstitch machine

1. Seam Puckering:

Puckering happened due to tight inner thread during stitching.

Fig.5.7: upper side view of puckered stitch

Some other fabric defects:

- Gout,
- Broken and Slubby weft,
- Local Distortion and
- Slubs/contamination

Shrinkage checking system in fabric:

In 4-point system physical checking is done. It is also major checking or test. Fit is basic concern of garment. A customer will not purchase ill fitted garment. Just to make better fit test is mandatory. Fabric pc is used in industry to gauge the shrinkage percentage. Based on contain of fabric like cotton, polyester, wool etc. Washing test on specified temperature has to be performed. To perform this test one has to determine directly percentage dimensional changes for various fabrics. Take two calibrated fabric pcs of 25x25 cm (length wise and width wise). Wash one swatch at specified temperature in specified cycles then dry in dryer.

After that evaluate both fabric pieces to determine dimensional shrinkage in percentage.

B) Thread: In selecting of thread following points has to be check:

- Ticket size/thread number
- Ply
- Twist
- Color

- Tenacity
- Elongation
- Winding
- Elasticity

C) Trims/accessories checking:

Trims and accessories are small objects to use ornamentation or safety purpose in garment. Like button, zippers, fasteners, draw cords, eyelets, hooks, buckles, various labels, wash cares etc. What need to be check in trims:

1) Wash care has to be check with fiber contents
2) Color fastness to be check of zippers, threads, buttons, draw cords, buckles and labels
3) Check accessories and trims with tech packs whether it is as per buyer or not
4) Strength of buttons & color matching
5) Zippers smoothness, zippers suitability for ex: light weight zippers for sheer or light fabric, for heavy weight fabric-metal zippers are suitable
6) Thread color should be match with fabric
7) Color fastness of fusing, lining and threads

2. DEFECTS IN PROCESS PRODUCTION SYSTEM:

In production system checking is done for following:

A) Marker checking: CAD operator should check properly that all garment components are there in marker as per required ratio, and fabric consumption is high. Pattern direction as per grain line should be check. Notches & drill marks should be on adequate place. Checks & lining should be match.

B) Cutting components: All the components and fabric trims like collar, pockets, lining, neck tape, rib etc. should cut. Ticketing will be done properly. So that bundle will not mix. Bundles and cutting components have to be check. If bundling is not done properly there is 100% chance of shade variation and mixing of sizes. Bundling is done by fabric rolls and sizes.

C) Sewing checking: A line checker has to check each operation on machines to ensure proper quality.

D) Needle damage/use of wrong needle: We have studied in needle section that use of wrong needle or broken needle damage fabric. Needle should be used according to seam, fabric and thread otherwise there will be holes and others defects during stitching.

E) Finishing Check: Ironing, folding, tagging, bar-coding and packing are main operation which are performed in this section. A checker has to check following points to ensure quality:

- No color shading due to hot iron
- There should not be any mark/spot on garment
- Creases and folds should be smooth and accurate
- Correct labels and tags

Fig.5.8: Tilted label

- Barcode should be correct
- Garment should be buttoned

3) POST PRODUCTION INSPECTION:

A. Garment checking after sewing: This is final checking of garment. In this procedure a checker has to check measurements as per spec sheet. They have to check every single garment of lot. Following points has to be check in final checking:

- Measurements as per spec sheet of each size
- Color & silhouettes matching to approved sample
- SPC (Stitches Per Centimeter)
- Wrong or missing main brand labels, size labels

- Wrong or missing care labels
- Missing or broken buttons
- Faulty zippers and other trims
- Stitch strength
- Loose or broken threads
- Pulled or loose yarns
- Needle cuts
- Stains
- Holes or other fabric defects
- Overall look or right formation of garment

B. Packed Garment Checking:

- Ensure label
  Measurements of garment
  Specification tolerance for garment dimension
  Result of pull test/fatigue test/stretch test
  Confirmation to legal requirements
- Ensure packaging
  Bag sealing method
  Bag size
  Barcodes
  Retail art work and printing
  Carton specification

Benefits of Good Quality

If some products are produced, there are two factors which count, either good quality or bad quality. These are some benefits of good quality garments.

A. Comfort in using
B. Good stitching quality
C. Good body fitting
D. Long life of garment
E. Proper financial return

How to control quality?

1. Have the proper approach toward operator
   A. Approach operator with defective garment.
   B. Ask operator kindly to stop the work and pay attention.
   C. Explain defect found and ask if he/she understands why garment is defective.
   D. Make sure operator understands why it is defective.
   E. Try to find out reason for the defect. Ask the operator why it was not detected at the workstation.
   F. Restate the company's commitment to quality.
   G. Ask operator to inspect the current bundle for the more defective parts and then repair all parts that are out of tolerance including the one found by the inspector. This should be done immediately.
   H. Stay and observe sewing method. Make sure right method is being followed.
2. Train operator to sew with good quality from the beginning and follow at each step.
3. Operator must be aware about various defects which can affect quality
4. Line checker and other checkers must follow PP (Pre Production) sample
5. Know quality specification and tolerances.
6. Be sure you understand what constitutes good and poor quality.
7. Be consistent in your decisions toward quality.
8. Comment on both good and bad quality. We all have a tendency to be silent during good times and vocal during the bad.
9. Be sure to check each operator's work daily. The amount of defects found should govern the amount of inspections performed.
10. Use a check list – Do not rely on memory of specs.
11. If checker/line in-charge finds any problem, they must solve it with plant manager.

Activities

Activity 1: Check the garment according to AQL level chart.

Material required:

1. Batch of garments

2. AQL chart
3. Measurement sheet
4. Measuring tape

Step by Step Procedure:

1. Take the garments
2. See the AQL chart and the find your batch size into them.
3. Then start the checking of the garment defects and measurement both.
4. Give your result as batch of garment is accepted/rejected.

Check Your Progress

A. Fill in the Blanks:

1. AQL means_____ _____ _____.
2. Garment without any defect with proper fit, fabric, design at acceptable price is a _____ garment.
3. _____ happened due to tight inner thread during stitching.
4. DHU stands for _____ _____ _____.

B. Questions:

1. What is AQL level? Why it is important for an industry.
2. Discuss defects found in fabric.
3. Write in brief how to control quality in garment production.

Session 2: Faults/Defects in Stitching Process: Types And Remedies

In garment manufacturing process, several defects are bound to be there if proper care is not taken. This is most important factor to know and it saves our time and money also. The defects generally found during the production process can be classified in groups which are discussed as followed:

CLASSIFICATION OF DEFECTS:

A. Minor Defects: These types of defects are very easy to remove and after repairing they do not affect the quality. Defects are like (Stain, Skip Stitch, wrinkles etc.)

B. Major Defects: These types of defects are very hard to remove and after repairing they take much time to remove and extra effort. Defects are Like (Collar change, sleeve change, short measurement etc.)

C. Critical Defects: These types of defects are not made to repair; they can only be the rejected garments. These types' defects are: hole, cutting, shade variation, paint mark etc.

CAUSES FOR THE DEFECTS DURING THE STITCHING

A. Improper cutting feed to sewing section

B. High seam margin cut during the sewing (defect occur short measurement)

C. Color miss match between thread and body fabric (defects occur shade variation)

D. Defects occur by improper handling also (like crease mark, wrinkles, stain, etc. all the factor to effect the garment quality).

E. Improper needle used during the sewing (needle hole problem)

F. Improper sewing machine setting (SPC miss match this is also a defect)

FIND THE PROBLEM /DEFECTS

This is the most important thing to learn it comes only on regular practices. Divide a garment in three sections:

1. Section-A (half front upper side)
2. Section-B (half front lower side)
3. Section-C (whole back side)

In the section-A there is no any minor defect allowed. In the section-B there only one minor defect is allowed and last one in section- C there only two defects are allowed.

SEWING/STITCHING DEFECTS:

Sewing defects can be classified in three groups:

A. Problem of stitch formation.

B. Problem of puckering.

C. Damage of fabric on seam line.

A. Problem of stitch formation:

i. Slipped Stitch: Stitches in the seam line are present in a regular manner. If the inter looping or interlacing between top & bottom thread of stitch does not take place or missed is known as slipped stitch or skipped stitch. This is serious defect in case of chain stitch as compare to lock stitch. The following are the cause & remedies of slipped stitch formation.

Table 5.5: Causes and remedies of slipped stitch

No	Causes	Remedies
1	If hook or looper & needle are not inserted in loop of thread in time	Examine the setting & timing between needle & hook or looper. Placing the needle properly. More secure needle should be used.
2	Irregular thread tension on upper or lower loop	The tension of the thread should again be adjusted
3	Needle deflection	Needle to be changed
4	If needle thread loop size is too small	Needle size & thread size must be adjusted
5	Flagging of fabric during sewing	The pressure of presser foot must be adjusted accurately. The hole of throat plate & needle size must be adjusted
6	If the sewing thread is not capable to from loop	Thread to be changed

ii. Staggered Stitch: When the stitches produced by needle are not parallel or become curvy to sewing line it is known as staggered stitch.

Table 5.6: Causes and remedies of staggered stitch

No	Causes	Remedies
1	Needle deflection	Increase the needle size tapered needle should be used
2	Due to wrong blunt needle point	Needle should be changed
3	Wrong adjustment of needle & thread size	Needle size & thread size to be changed
4	Deflected motion of feed dog	Motion of feed dog to be adjusted
5	If fabric are not controlled properly the feed mechanism	The pressure of presser foot must be adjusted accurately, feed mechanism to be changed.

iii. Unbalance stitch: This type of defect is found in lock stitch machines. If the interlacement of threads does not take place in the middle of two layers of fabric then it gives unbalance stitch. Following are the causes of unbalance stitch:

Table 5.7: Causes and remedies of unbalance stitch

No	Causes	Remedies
1	Wrong tension of sewing thread	Setting of proper tension to the sewing thread. Proper care to the twisting of the thread during sewing
2	Wrong adjustment of needle thread path	Use of right thread path
3	Snagging of needle with bobbin case & positioning finger	Bobbin case to be smooth. The positioning finger to be set again
4	Frequent breakage of thread	Better quality of thread must be used. Thread must be lubricated.

iv. Variable stitch density: Stitch per unit length should be uniform, if is not then it called variable stitch density. The main cause if variable stitch density is irregular feed of fabric due to insufficient pressure of presser foot.

Table 5.8: Causes and remedies of Variable stitch density

No	Causes	Remedies
1	Improper unwinding of thread from package from package during sewing	The position of thread guide must be 2.5 times higher than the position of thread package. Also proper care should be kept to the thread package not to tiling
2	Twisting of needle thread in the bottom of the thread package	Foam pad must be used to the bottom of the thread package
3	Snarling of thread before tension disk	Winding of more threads in the thread guide & to keep less tension to the tensioning disk
4	Twisting of thread in the thread guide	Proper threading of sewing thread during sewing
5	More tension to the thread	The tension of thread should be less or use high strength threads
6	Use of broken check spring	Check spring to be changed
7	If the edge of the throat plate, hook point, needle guard, bobbin case , needle groove , needle eye & so on are sharpened	The edges must be smooth & needle must be changed as needed.
8	Fraying of thread in the needle	Fine thread must be used or use heavy needle
9	Thread gets heated More	High quality needle must be used, needle lubricant must be used ,beadle cooler must be used
10	Hook gets heated more	Lubricant must be available. Examine the distance between the needle & hook
11	Use of low quality threads	Thread to be changed

v. Frequent thread breakage: Frequent breakage of thread especially, when there needs to open out the sewing to solve the problem. The following are the causes & remedies of frequent thread breakage.

Table 5.9: Causes and remedies of frequent thread breakage

S. No	Causes	Remedies
1	Wrong winding of thread on to the bobbin	Proper winding of thread on to the bobbin pre- wound bobbin may be used
2	More tension to the bobbin thread or more rotating of bobbin	The tension must be adjusted to the bobbin thread. Use of washer to prevent more rotation of bobbin
3	If the edges bobbin case, looper eye & so on are more sharpened	The edges to be smooth.
4	Wrong fitting of bobbin case	Examine the size & type of bobbin. Examine the damaging of bobbin case

vi. Broken Stitches: When the stitches are broken during sewing is called broken stitch.

Cause: Where the thread is being broken where one seam crossed another seam?

(For e.g.: Bar tacks on top of waistband stitching, seat seam on top of riser seam)

Remedies:

1. Where the thread is being cut, use a large diameter thread on operation.
2. Make sure the proper stitch balance is being used.
3. Use needles with appropriate needle point.
4. At regular intervals on operations, change the needle where they occur frequently.

vii. Puckering: Puckering is a form of wrinkle along a seam line in a smooth fabric. It is one of the regular occurring defects. Puckering shows that there is too much fabric & not enough thread in the seam & as if the thread is drawing the seam in. This is the reason why sewing thread is often blamed

for causing puckering though there is other factor as well for cause of puckering. They are given below:

A. Fabric structure

B. Seam construction

C. Needle size

D. Material feeding problem

E. Wrong thread tension

F. Unsuitable thread

viii. Extension of sewing thread: If the tension on needle thread is higher than the under thread, then seam produced will be distorted.

Due to tension, the length of thread is extended slightly. When the fabrics are displaced from the machine after sewing, shrinkage of thread & fabric occurs due to their tendency of coming to original position.

If the shrinkage percentage of thread is higher than the fabric, seam puckering is observed. To avoid this, maintain sufficient thread tension and shrinkage.

Over and above mentioned defects other points to be kept in mind are:

1. Mismatched patterns
2. Sizing defects
3. Ironing

General maintenance of sewing machines:

1. Blow air on machine every day to remove lint and trash
2. On lock stitch machines, blow air on the hook regularly during the day to prevent lint or dirt from building up in this oil ports.
3. Check to see that the machines are being lubricated regularly.
4. Check Oil levels daily and add additional oil to top up, if necessary.
5. Randomly check the oil levels in the machines.
6. Use high quality white machine oil which not stains.
7. Check to make sure that the oil is not contaminated.
8. Check to see that oil reservoir pump filter is cleaned regularly.
9. Check the rusted areas in the machine due to excessive moisture in the production area.

Activities

Activity 1: Prepare chart of fabric defects with three classes of the defects.

Materials Required:

1. Pictures of garment with defects.
2. Chart sheet
3. Pen/pencil, color pencil, eraser
4. Glue
5. Scissors

Step by Step Procedure:

1. Note down the defects in the picture of the garment.
2. Use the arrow to mark the defects.
3. Cut the picture neatly.
4. Paste and label the pictures on the chart sheet.
5. Place the chart in classroom or practical lab.

Activity 2: Identify defects in garments and suggest remedies for that.

Materials Required:

1. Different types of garment.
2. Pen/pencil
3. Alter sticker to denote the defects
4. Practical file
5. Glue
6. Scissors

Step by Step Procedure:

1. Take garments and check all section to find the defects.
2. Use the arrow to mark the defects.
3. Find the ways to remove the defects by referring the list of defects.
4. Paste the samples in practical file.
5. Label them.

Check Your Progress

A. Fill in the Blanks:

1. _____ defects are very easy to remove and after repairing they do not affect the quality.
2. High quality_____ machine oil does not stain.

B. Questions:

1. Classify defects and give their examples.
2. Explain the reasons of defects caused during stitching.

ANSWER KEY

MODULE – 1

SESSION 1:

A. Fill in the blanks

1. Specification sheet
2. Ornamentation instruction
3. Proto sample
4. Sample approval

B. Match the columns

1. (b), 2. (d), 3. (e), 4. (c), 5. (a)

SESSION 2:

A. Fill in the blanks

1. Mass production
2. Buyer
3. Raw material
4. Sampling

B. Correct Sequence of activities:

(a) 3. Meeting with buyers
(b) 7. Development of initial samples for the buyer
(c) 8.Development of fabric sample, bit loom, print and embroidery artwork
(d) 5.Costing of garment (complete cost as well as manufacturing cost)
(e) 2.Pattern making, correction of pattern, pattern grading
(f) 9.Fit sample, size set sample making and approval from buyer
(g) 1.Correction of fit samples according to buyer comments
(h) 11.Production planning, Material planning and line planning
(i) 12.Placing order for fabric & Trims

(j) 4.Testing of fabric & trims

(k) 10.Study of Approved sample

(l) 6.Pre-production meeting

SESSION 3:

A. Fill in the blanks

1. Piping foot
2. Ruffler
3. Darning

MODULE – 2

SESSION 1:

A. Fill in the blanks

1. Four
2. Chain stitch
3. Thread guide

SESSION 2:

A. Fill in the blanks

1. Buttonholes
2. Stitch setting
3. Take up lever

MODULE – 3

SESSION 1:

A. Fill in the blanks

1. Knit
2. Eye guard
3. Cylinder

SESSION 2:

A. Fill in the blanks

1. Curved
2. Convex
3. Hemming and facing

SESSION 3

A. Fill in the blanks

1. Lock stitch
2. Decorative
3. Discontinuous, continuous
5. Buck
6. Steam

MODULE – 4

SESSION 1:

A. Multiple Choice Questions:

1. (a) Physical Hazards
2. (a) On site emergency
3. (b) Electrical Hazards
4. (d) Organization Evacuation Plan

SESSION 2:

A. Fill in the Blanks:

1. Repetitive
2. Ergonomic
3. Windows
4. Masks

SESSION 3

A. Fill in the Blanks:

1. Reuse, Recycle
2. Raw materials

SESSION 4:

A. Fill in the Blanks:

1. Guidelines and practices
2. Guidelines or instructions
3. Laws and regulations

MODULE – 5

SESSION 1:

A. Fill in the blanks

1. Accepted Quality Level
2. Quality
3. Puckering
4. Defects per Hundred Units

SESSION 2:

A. Fill in the blanks

1. Minor
2. White

Lis of Credits

Graphics

Verma Prachi – Fig. 1.1 (a,b,c,d), 1.2 (a,b,c), 1.3 (a,b,c), 1.4 (a,b,c), 1.5 (a,b,c), 1.6 (a,b,c), 1.7 (a,b,c), 1.8 (a,b,c), 1.9 (a,b,c), 1.10 (a,b,c), 1.11 (a,b,c), 3.6, 3.7,
3.14, 4.2, 4.3,

Photographs

Choubey Akshay – Fig. 2.1, 2.2, 2.3 (a,b,c,d,e,f,g,h), 2.4 (a,b,c,d,e,f), 2.5, 2.6 (a,b), 2.7 (a,b,c,d,e,f,g,h), 3.1, 3.2 (a,b,c,d,e,f,g,h,I,j, k), 3.3, 3.4, 3.5, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 4.1, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8